INTO THE DEEP SM

PRESENTED BY RTX

@hypebirds

@hbirds16818

HYPE BIRDS 16818

Team 16818

Engineering Portfolio

FTC Mexico | Mexico City | 2024-2025







Content

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Sponsors

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CAN QUEENS 25668

We would like to thank our sponsors for making our journey possible this season. We are beyond happy to be navigating by your side!

About us...

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Hype-Birds was founded 6 years ago, to create a community that **didn't focus only on robots,** but also on the **future of our planet.** Our objective is that every member in the team develops new talents, that's why, when the team was created, it was divided into **7 different areas:** Communication, Finance, Hype-Girls, Eco-Birds, Hype-Xolotls, TototlKali and Engineering. Each area is focused on creating a positive **impact in our community.**

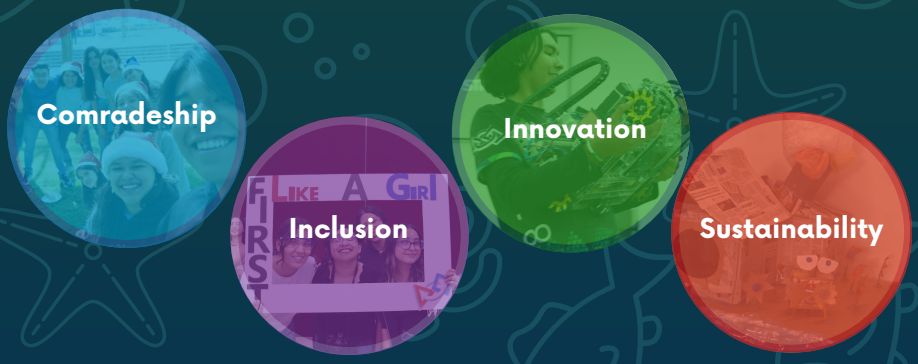
Mision

Hype-Birds seeks to **motivate** young people to create a **change in their environment**, providing them with tools for them to **have a personal development** that will be useful in different areas of their lives.

Vision

Being a team in the **FIRST®** community, which **joins the sustainability with the technological advancement,** creating an effective bond **between the human and the planet.**

Values



Diversity

Two of the **core values of the team** are **inclusion** and **respect.** We celebrate the diversity. We know that we can all **show our potential and motivate others** regarding our genre or sexual orientation.

16818 Members, contributions and future development

Engineering · Hype-Xolotls · Hype-Girls · Eco-Birds · Communication · Finance · TototlKali

Amanda - Rookie
Contributed in the robot's iterations. Dean's List Semifinalist.

→ Team programmer

Isabella - Rookie
I shared #FIRSTLikeAGirl and helped with the robot's math. Dean's List Semifinalist.

→ Mechanic leader

Alejandro - Rookie
I shared our projects in the Maker Faire and helped building the robot. Co-Driver.

→ Team programmer

Kim - Junior
I contacted enterprises looking for strategic alliances and sponsors.

→ Finance captain

Mariana - Junior
I participated in the Zero Waste Week to promote environmental awareness.

→ Eco-Birds captain

Isaac - Junior
I contributed in the creation of the robot code. TeleOperated and autonomous.

→ Team captain

Carlos - Veteran
I contributed with the mechanics of the robot. I proposed new mechanisms.

→ Mechanical Eng. @ TEC

Aitana - Veteran
I coordinated the weekly meetings to follow-up all our projects.

→ Pedagogue @ ITAM

Paulina - Veteran
I helped with the design and writing of the Engineering Portfolio and interview.

→ Communication @ TEC

Karime - Veteran
I helped with the Get Up Tec organization, as well as the finances and team sponsors.

→ Law School @ TEC

Ramsés - Veteran
I learned about social media management and coordinated the content creation.

→ Industrial Eng. @ TEC

Natalia - Veteran
I coordinated the awareness projects of our environmental area.

→ Sustainable Eng. @ TEC

Fernando - Veteran
I have been a FLL and FTC volunteer the past two years.

→ Data Sience @ Columbia

Sergio - Veteran
I designed many of the robot's mechanisms and guided the rookies along the construction.

→ Mechatronics Eng @ TEC

Yunuén - Veteran
I contributed in the development, planning and publishisng of our projects.

→ Biology @ UNAM

→ Future development and career plan

Coaches and Mentors

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Victor
Team coach

José Emilio
Engineering mentor

Bernardo
Programming mentor

Juan
Finance mentor

Alondra
Social impact mentor
Drive Coach

HOW DO WE RECRUIT MENTORS?

100% of our mentors are **FIRST Alumni,** from which 80% were previously **members** of the team. Our recruitment process for mentors consists of showing our projects through lectures and simulations of the robot's challenges. Afterwards, we get in contact with the interested students to know them better and evaluate the areas in which they can contribute, therefore obtaining **diverse perspectives** and an insightful knowledge. Furthermore, we ensure to **expand the world of FIRST** to college students that can no longer participate as youth members.

OUR MENTOR'S JOURNEY INSIDE THE TEAM

Our mentors **enter the team as members** and learn about robotics, social impact and FIRST core values.

After 3 seasons, **they become FIRST Alumni** and start applying their **knowledge in their daily lives.**

With the knowledge of their careers and what they learned in the team, **they instruct the new members.**

Our learnings this season...

What did we want to learn?	How did we learn it?	How did we apply it?
Programming	Bernardo prepared classes in which we learned everything from the basics of programming to object-oriented programming.	Now we use new libraries such as RoadRunner.
Mechanics	In the workshop, José Emilio taught us how to use different pieces to create innovative mechanisms.	In the mechanisms and iterations of the robot.
Finances	In weekly meetings, Juan trained the finance area to obtain sponsorships and manage our income, taking advantage of his experience as a finance student.	We use the money raised to fund the robot and some team events.

OUR LEARNING PROCESS

Our mentors prepare and give **training sessions** for all the team members.

We attend to the training sessions, **clarify our doubts** and learn together.

We **apply our knowledge** and if there is a mistake we try a new method.

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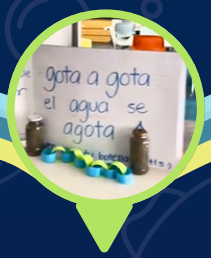
Team Plan

This season, we established **five goals** from the beginning in order to **inspire** as many people as possible, as well as to finance the team with the least amount of difficulties. Our goals are:

CONNECT

Organize events to **CONNECT** within the **FIRST®** community.

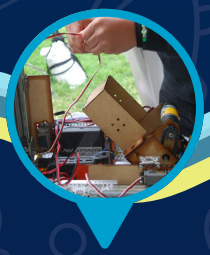


MOTIVATE

Inform our community about **environmental problems** and **MOTIVATE** them to make a change.

INNOVATE

INNOVATE learning processes in order to make them more **accessible** for younger generations.



SUSTAIN

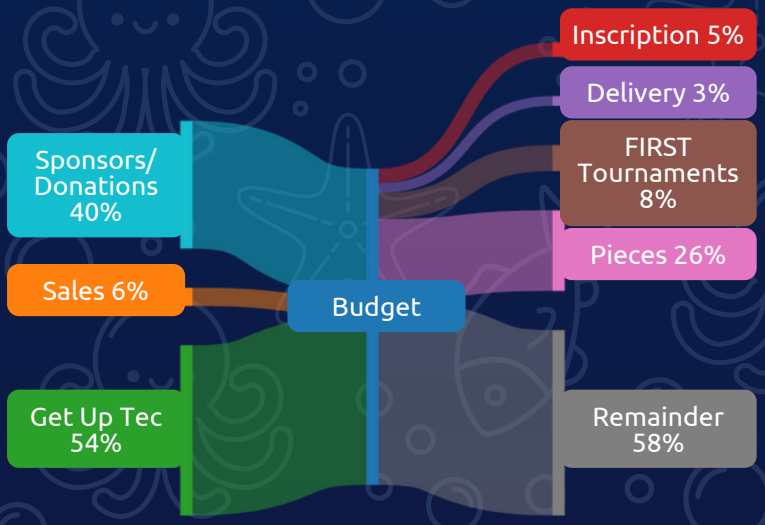
Raise **enough funds** on our account to **SUSTAIN all the expenses** required by the team.

DESIGN

DESIGN a **safe environment** where everyone's skills are **highlighted** and inclusion is encouraged.

Sponsorship and Finance

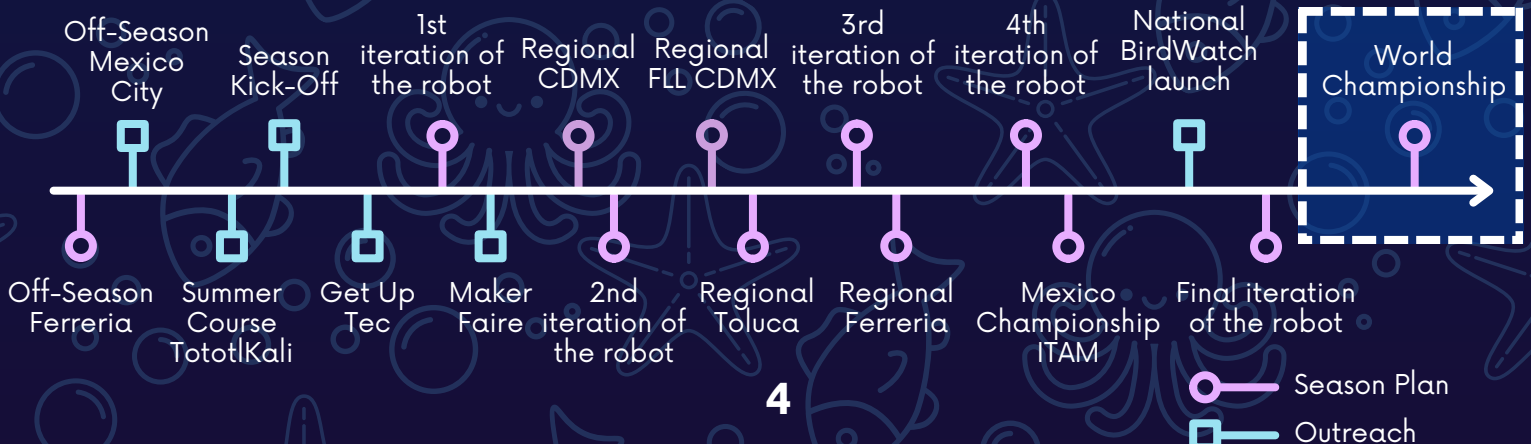
This area **generates and manages our income**, searches for **sponsors** and promotes **strategic collaborations** with them. This season it raised **over $100,000 MXN**, mostly from selling tickets for **Get Up Tec.** A **sustainable economy** was prioritized to pay our expenses for the season while minimizing our environmental impact. Moreover, **strategic alliances** were established for the **manufacture** of pieces and the **accommodation** in Mexico City for the **other teams participating in the Mexico Championship.**



Communication and Marketing

We are responsible for **sharing and promoting the team worldwide.** We use our **social media accounts to share our projects** and advertise the team. This season, we focused as well on other types of outreach, mainly inside our school's media, as well as in the development of our website and the uniform for this season.

This season's timeline



Connect, learn and grow together... 16818

Off-Season Centerstage:

To promote the uniting and the fellowship inside the FIRST® Mexico community, we organized an **Off-Season Championship** of the **CENTERSTAGE**℠ challenge where the **center region of Mexico** attended to have fun and remember those moments of the season that we lived. This event helped us to establish relationships with other teams and to **motivate** our rookie members to be more involved in **FIRST®.** Also, the event allowed us to create a environment without pressure so that the teams could innovate with their robots. During the event, different **workshops were given** about the creation of the **engineering portfolio,** strategies for the **judge interviews**, and others

Learning:
Learn how to manage substantial crowds in order to keep organized and efficient spaces during an event.

Plans for the future:
Continue with the logistics of events that allow us to connect with more teams.

Into The Deep Events:

To start the season, we joined with 5 other teams to watch the **launch of this season's challenge.** Thanks to this event, we promoted **coopertition**, as we were able to share our ideas, **connect** with the teams and enrich everyone's perspective.

Also, this year we had the opportunity of being **hosts of the first regional competition of FTC** at Tecnológico de Monterrey Mexico City. This event allowed us to recognize the importance of the volunteer's work and continue **expanding our knowledge in the FIRST® currents.**

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Building together, #FIRSTLikeAGirl and M.E. FIRST:

For 2 consecutive years, we have been selected as **ambassadors of #FIRSTLikeAGirl.** On our social media, we share **our experience as women in FIRST®, inspiring** more girls to join the world of STEAM. As ambassadors, we must **seek for the wellbeing** and enjoyment of women **during the tournaments.** Due to the aforementioned, we joined to the initiative **Menstrual Equity (M.E.) FIRST®** to guarantee that all women have access to **free menstrual hygiene products** during the tournaments.

Learning:
Motivate girls to participate in STEAM goes beyond a post on social media.

Upcoming plan:
Search new diffusion channels on the media to give visibility to women in STEAM.

Maker Faire:

The team CanQueens 25668 invited us to participate at the **Maker Faire,** a space committed with creativity and **innovation.** During the event, we **shared our projects** with the attendees, presenting our robot and encouraging other people to **discover FIRST®.** Thanks to this, we got in touch with other teams of FTC and FRC, schools and enterprises to collaborate with them and **enhance our passion for STEAM.**

Learning:
Communicating our projects with others enables us to establish connections with people with similar interests.

Upcoming plan:
Organizing our own event where multiple organizations and enterprises engaged with innovating inside the robotics field attend.

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BIRDWATCH
Seagull [2024 ItD] Beta 1.2.0.0
For Windows 10 (exe)

Innovate scouting:

With our programming mentor's help, we developed **a an application** to ease the **scouting strategy.** The software analyzes in real time the **official scores** of the matches per period and team, therefore we can know the strengths of other robots competing in the same events as us. This software allows us to **find the most compatible robot** with ours during the formation of alliances. During Mexico's championship, we were able to **share BirdWatch with more than 50 teams.**

Learning:
Linking scouting with technology, programming and designing a software with the help our mentors.

Upcoming plan:
Make the necessary improvements and arrangements to launch it worldwide for its use.

Connect4FIRST®:

- **Team calls:** We contacted Mechrams 18341, Aztech Robotics 17625 and Wizards 18422 to talk with them about how we are **approaching the challenge** of the new season and **share our robot designs.**

- **Team hosting:** In **alliance** with Grupo Brisas (a hotel chain), we got a discount at the Galería Plaza San Jerónimo hotel so that teams **attending the Mexico Championship,** could stay **paying a lower price.**

- **Advice from other teams:** Pink Hawks 6606 and Java de Hutts 14725 (winners of the inspire award in their region for 5 consecutive years) **advised us on the correction of our portfolio.**

Learning:
How to keep contact with other teams throughout the season and enlarge our support network.

Upcoming plan:
Search for more alliances with organizations that benefit FIRST teams around the country.

Inspire to fly higher...

Eco-Birds:

Eco-Birds is a space dedicated to **community support** and **environmental awareness** in Mexico. In this area, we carry out dynamic and educational projects to **support the environment**. We believe that environmental activism is a **fundamental part** of the heart of our team.

• Zero Waste Week

We dedicated a week at our school to **raise awareness in our community** about the impact of our waste on the environment. After **collecting PET bottles and Tetra Pak containers** using voting as an incentive to encourage donations, we created artworks representing the damage to the oceans caused by common-use plastics, which were then displayed to the community.

• H20ptimization Project

After collecting **more than 300 PET bottles**, we reused them by filling them with sand and distributing them to our community. These bottles were **designed** to be placed inside toilet tanks so that **less water was used with each flush**, saving approximately **36,000 liters of water per month.**

Learning:
We can link mathematics with our environmental consciousness projects.

Plans for the future:
Enlarge the life span of our resources in order to avoid making unnecessary purchases.

TototlKali:

At TototlKali we are **passionate about education.** We have imparting summer and winter courses to children for more than 3 years. In the courses we provide education in **STEAM subjects** through **dynamic and innovative** learning methods.

• Summer Course 2024

In July, a two-week course **(80 hours)** was held at our school facilities, **impacting more than 30 children aged 6 to 12**. The course covered topics related to sustainability, physics, mathematics, and robotics.

• Book collect

Seeking out that people discover new worlds and receive an **integral education**, we organized a book fundraiser in which **more than a 100 books** were given **a second chance by being donated.** Furthermore, we sorted out a **blind date with a book** inside our student body to incentivize the donations.

• Astro Birds

During the last period of 2024, **planning** began **for a course** with materials provided by the **NASA** which will take place on the **June of 2025** seeking to impact more than **30 children.**

Learning:
Observe different points of view before taking a decision.

Plans for the future:
Inspire younger generations to learn about STEAM through a practical learning.

Inspire to fly higher...

Hype-Xolotls:

We are convinced that **science** should be accessible for everyone. The objective of Hype-Xolotls is to **connect with schools** to collaborate with them and provide **children** an **approach to engineering** and robotics.
Whether **mentoring a FLL team** or designing **STEM courses** for them to develop engineering related skills, we seek to **inspire them to become part of this areas.**

- **Hosts FLL Regional Mexico City**

This year, aiming to encourage the younger generations to get involved in the world of FIRST®, together with Can Queens, we were **organizers and volunteers of the regional FLL tournament** held at the Tecnológico de Monterrey Campus Mexico City. Where we could observe the world of robotics from the perspective of the **younger members of FIRST®.**

- **Robotics at the colegio Madrid**

To reinforce the knowledge of robotics of **more than 30 elementary school students** a month long (**20 hours**) course was held, **contributing** to their development in the robotics field. With worked with the **programming** or Arduinos and Botley. Furthermore, we created labyrinths and mazes as challenges for the students.

Hype-Girls:

More than 50% of the members in Hype-Birds are **women**, therefore we created this area to **motivate** to continue their pathway along STEAM and be a **support network.**

- **f<A+i>R**

The girls on the team participated in an **international webinar** where they shared their opinion about **artificial intelligence,** approaching it from the perspective of **robotics and the environment.**

- **Menstrual Equity FIRST®**

We joined to the initiative **M.E. FIRST®** to ensure the access to **free menstrual hygiene products** at the events Hype-Birds attends and generate awareness about the importance of accessibility of these products.

- **Lectures #FIRST®LikeAGirl**

We invited the **girls inside of FIRST®** to give lectures at the Off-Season. Likewise, we invited Doctor Stephanie Ordoñeza to impart a lecture about leadership, at the regional FTC Mexico City. We want to **learn about the experience** of other women and **connect with them** through this type of events.

- **National radio program**

Due to the **success of our projects,** we were invited to **RADEEAL,** a program recorded at the **Torre Latinoamericana,** to talk about our experience at **engineering and environmental awareness.**

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Robot Changes Roadmap

	Change	Improvement	Lesson
December	1. The **climber** has been one of the most **consistent** parts of the robot. 2. The **first autonomous wasn't very effective** and was rarely used. 3. The **light materials** helped a lot while driving the robot and climbing.	1. Developed a system for **first level climb.** 2. Implemented an **autonomous period** to score points early. 3. Installed light materials in the chassis such as **polycarbonate and acrylic.**	1. The **climb** took less time as expected and only **inclined the sliders minimally**. 2. We realized that the **autonomous period** is **essential** and had to refine it. 3. Learnt to **work with new materials** that we can use in the future.
January	1. Implemented the **differential claws** in the intake and the outtake. 2. Installed **retractable keychains** to secure the cables. 3. Made the chassis more symmetrical and **placed an exo-skeleton** on the intake.	1. The differential claws were more **rigid, robust and simple.** 2. The keychains prevented several **accidents** with the cables. 3. The **intake** stopped vibrating, making it more **precise and consistent.**	1. Materials like **TPU** help a lot with the **claws' grip**. 2. Although we try to prevent it, there's always **risks with the cables.** 3. We have to be careful with the **assembly so that it's not forced.**
February	1. Placed a **protector** for specimens/samples. 2. **Reinforced** the intake and outtake with bands. 3. **Redesigned** the autonomous and focused on scoring specimens in our strategy.	1. We haven't had problems with **stuck game elements.** 2. There is less **force** being applied on the **servomotors.** 3. We now score more **points at the start** of the match, giving us a **good head start.**	1. **Freeing** the **game elements** has saved several matches. 2. The **positions** of the **motors changed** slightly, so we **altered the programming.** 3. We have to **pay attention to** the initial position of the robot.
March	1. **Redesigned the intake** with pulleys and 3D printed reinforcements. 2. Placed **physical stops** in many parts of the robot.	1. Now the motors receive **less strain** and the intake is less prone to breakage. 2. We can **prevent overspin** in many parts.	1. We have to pay attention to the **strain on 3D parts.** 2. Applying physical stops can **ease the programming process** and ensure none of the mechanism get damaged.

Trade-offs in the season

- We had the opportunity to be the hosts of the Mexico City Regional FTC competition. We decided to dedicate **50% of the revenue** from Get Up Tec to the **organization of the regional**.
- In the robot, we prioritized scoring **specimens** rather than scoring samples in the basket because the mechanisms of our robot and its specifications were better suited for specimens.

Risk Management:

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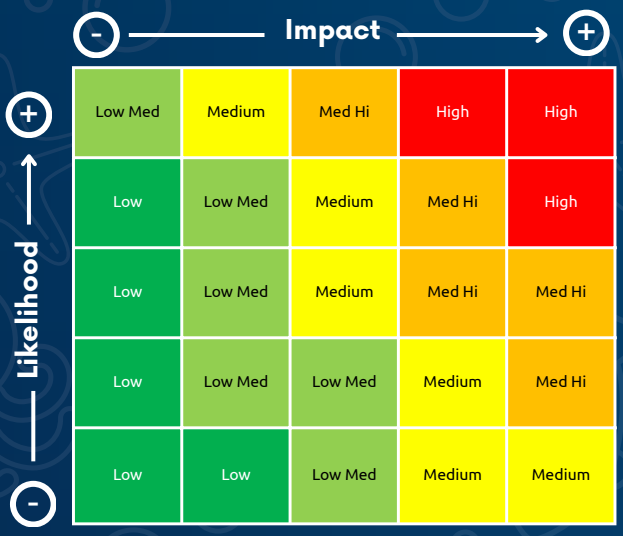
Risk	Contingency plan
3D parts are fragile and some of the ones in the intake are difficult to replace.	Preparing spares and training the pit crew to fix the robot quickly.
The sample gets stuck inside the chassis, we can't continue scoring during the match.	Adding a piece of acrylic covering the chassis.
The match can go south in a moment and halt our plans.	Create contingency plans with the drive team.



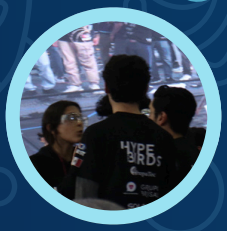
Engineering

Robot:

We present **"OctoPaul"**, our champion for the Into the Deep season, a robot that has had a total of **5 intake iterations and 6 outake iterations**. For its creation, we had to **implement several techniques and mechanisms totally new to us**, but that, thanks to our research, tools and the joint dedication of members and mentors, we have been able to reach the most competitive robot in the history of the team.

Strategy:

Upon **analyzing the strategies** and our performance at competitions we changed from a strategy where we would score samples and specimens, to **scoring only specimens**. However, the mechanism we used was **inaccurate**, so we wanted to adapt our outtake but the pieces were stopped in customs. But, we noticed that our intake was very efficient, so our final strategy consists on being the best **support robot**. We **score samples** on the high-basket and **feed samples** from the submersible to the human player.



Current Strategy:

TOTAL : 141 pts

1. Autonomous

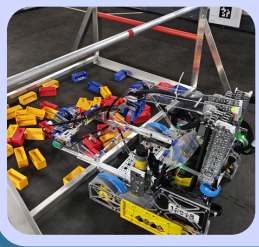
Our **autonomous** opts to be **powerful** and **flexible**:

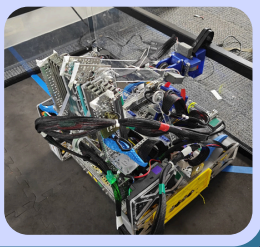
1. Scores **4 samples** and it parks. It is our main one and it makes the most points. **(+67 pts)**
2. Scores **3 specimens** and it **parks**. Secondary auto, only used if alliance has samples auto. **(+63 pts)**

2. TeleOp

Our **TeleOp** is focused in one thing: scoring **MANY samples**.
We think that it's best to be **excellent** at a specific task in order to **master it**.
In our case, we use intake and outtake to repeat a scoring **cycle**, which we can do approximately **7 times per game**.

1. Pick up **7 samples** from the submersible.
2. Score those 7 on the high basket by moving the robot back and forth. **(+56 pts)**



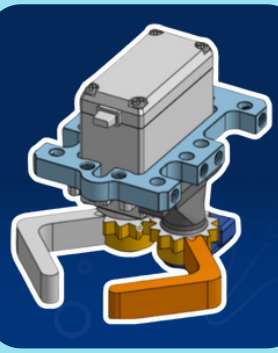


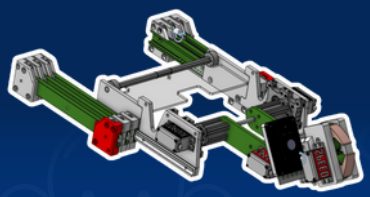
3. Endgame

We use **20 of the 30 seconds** of the **Endgame** to keep scoring, and in the **last 10 seconds** we secure a **level 2 ascent**.
Unlike many teams that hang on the bottom bar, we do it directly on the top bar, **sacrificing a level 3 ascent**, however, this decision favors the **design of our outake (+18 pts)**.

First Intake Models

- When planning our robot, we were undecided between using a **roller** or a **claw.** After testing both mechanisms, **we decided to use the claw** because of its **efficiency**.
- The goal of the claw was to **feed the outtake** through a **transfer system.**
- We realized that this system had **many error factors,** for example, the **small margin of error** of the claw, the **agility of extension**, and the **number of servo motors** it used.

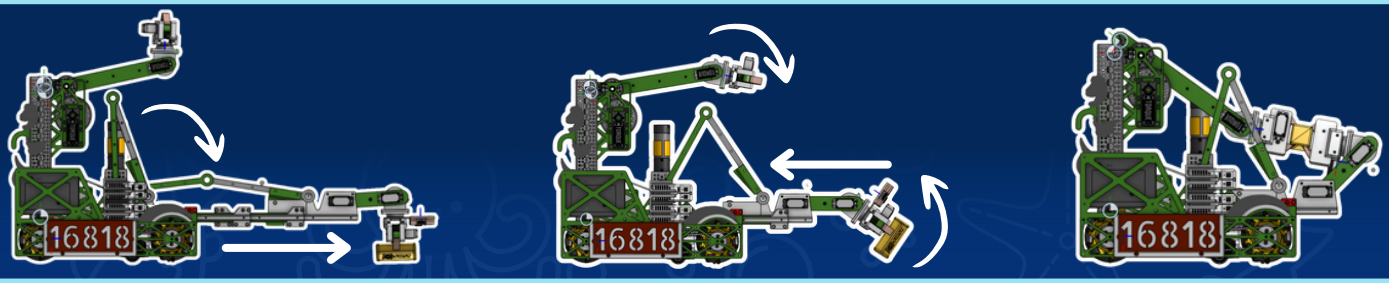




Final Intake Models

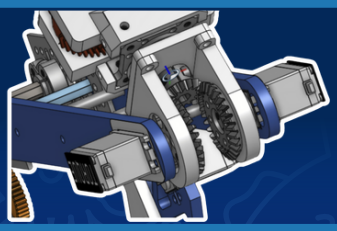
- The system features **two pairs of three Misumi linear sliders**, driven by a motor for precise movement.
- On top of this base, **a double polycarbonate arm,** powered by the same motor, ensures stability and control.
- At the end, a **differential claw** allows versatile grips at different angles.

Transition from intake to outake



First Outake Models

- In the **first prototypes** of the outtake we used a **claw,** which would feed from the intake to **place the samples and specimens.**
- The **flaws** it presented were that, when placed in position, it **rotated horizontally too much** and could **damage other robots** or **go out of the field.** Also, the **grip** when placing specimens **was not strong enough** to hook them to the chambers.



Final Outake Model

- The latest **outtake** design incorporates **a stingray mechanism** and a 4:1 gear system, **supported by goBILDA sliders** for the arm to increase the angle.
- To enable the claw to rotate at multiple angles, it employs a **differential system** with **two speed servos** and a **2:1 gear ratio.**
- The claw, fully **3D printed with PLA, PETG and TPU filament**, is complemented by a **polycarbonate arm,** making it flexible and easy to obtain spare parts.

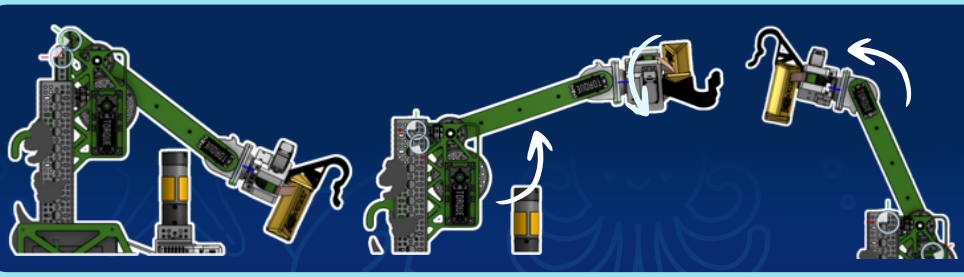
Calculating torque

The torque is calculated as the product of the mass of the gripper and the specimen (m) times the distance to the fulcrum (r). This force is 4 times that of the servo because of our gear ratio (15:105:60).

$$\frac{F_T}{g} = 21.6\text{kgcm} \times 2 \times 4 = 172.8$$

$$\frac{F_t}{g} = mr = 0.49\text{kg} \times 45.5\text{cm} = 21.64\text{kgcm}$$

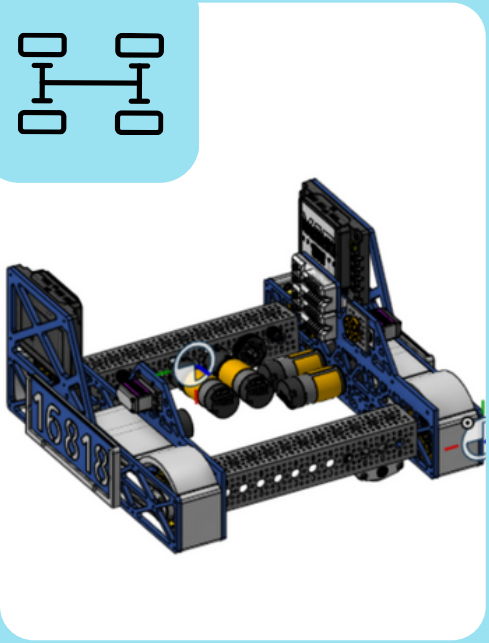
Deposition phases



Engineering - Chassis 16818

It is one of the most **important parts of the robot,** as well as the one in which we **implemented** the most **innovative techniques**. Our goal in designing it was to **keep the overall weight low** while maintaining **good structural strength**, a mission we **accomplished.**

Chassis Model



Main Advantages

Strong and **resistant** construction to withstand impacts and maintain a **solid structure.**

Lightweight material for better maneuverability and relatively **affordable** for spare parts.

Custom-designed spaces for chassis parts, **keeping everything secure.**

Manufacturing

- We planned to use **aluminum** for the profiles because it provided a high strength of **90 MPa** and a low weight of **2.7 g/cm³.**
- We ran CAD tests and saw that **polycarbonate** would be a better choice. Although it has a lower strength of **69 MPa**, if we used **twice** the material, we would get **almost the same weight.** For this reason, we decided to use **polycarbonate** in the chassis.
- All prototypes were made with MDF to reduce waste.
- **Polycarbonate** has a **low price,** which allowed us to manufacture several spare parts for the competitions. In addition, its **elasticity** makes it **less susceptible to breakage.**

Odometry rims: We use them to **estimate the position** of "OctoPaul", thanks to its movement and the **encoder.**

- We measure their movements and make sure that the readings of the encoders of the rest of the odometry rims are correct.
- They are aligned to the X and Y axes, located on the front and left profile.
- The encoders are used to count **the number of times the tire rotates.** However, it uses a **number of steps (n)**, which depends on each encoder, to count one revolution of the tire.
- Using the **formula for perimeter of a circle,** we calculate the **linear distance (d)** with the formula:

$$d = m \times \frac{2\pi r}{n}$$

"m" being the number on the encoder and, therefore, m/n being the number of turns a tire turns.

- That calculation is done for the tires on both sides, since the tires may or may not move with the same force, which determines whether **it moves straight ahead or turns.**
- The average of the distances traveled by the tires tells us **how far the robot moved** in a straight line, while the difference in the distances between the length and the tires tells us **how far the robot turned.**
- By knowing **how far it moved and how much it turned,** we can estimate its **new position.**
- The new **(x, y) coordinates** of the robot are obtained with the coordinates of the previous robot plus the displacement times the **cosine** (for x) and **sine** (for y) of the original **robot's orientation** plus half the amount it turned gives us the new coordinates:

$$y_a = y_0 + d \times \sin(\theta_0 + \frac{\theta}{2}) \qquad x_a = x_0 + d \times \cos(\theta_0 + \frac{\theta}{2})$$

3D Printing

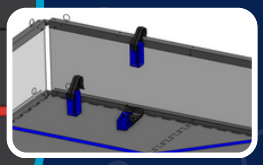
- We make **our own 3D parts with** 1.75 mm **filament** in different colors. This allows us to have more **freedom** in the designs of each element.
- We have mainly used these prints in the **various versions of the chassis** and the **claws of the Intake and outtake,** allowing us to make **modifications easily.**
- We use **PLA+ and PETG** to have more **hardness** in our parts.

- In this part, it is crucial to understand that **field-oriented control** is what allows us to be clear about **where the robot is going to move,** regardless of its orientation and without having to make additional turns when moving it.

Engineering - Programming

Main Autonomous (Specimen)

1. Using **pre-programmed trajectories,** we navigate to the **high rung** to place the **preloaded specimen.**



2. We move two of the **samples** on the **floor** to **convert them specimens** in the obs zone.

3. Make other cycles to **score 2 more specimens in the high rung.**

4. We end up parked in the observation area.

Secondary Autonomous (Samples)

1. Using **trajectories** we make the robot **score the sample** loaded in the **high basket.**

2. With the **intake** we pick up, **transfer to outtake** and score another **2 samples.**

3. We finally **navigated** to **park.**

Sensors Used

1. **Limelight:** Located in front of our robot, this camera is able to recognize an essential element for the operation of the robot: the samples. Through a color recognition algorithm, it detects the desired color of the sample. Afterwards, it draws the contour of the sample over the original image. Thanks to this, it can tell what angle the sample is positioned it and the relative distance from the camera where it's placed at, using the x and y axes of the camera.

2. **Control Hub Inertial Measurement Unit (IMU):** This sensor provides us with a **gyroscope capable of measuring the robot's angle in 360°.** This way, the robot can rotate during both the autonomous and TeleOp periods with PIDF (or Proportional Integral Derivative Proportional Feedforward Control Loop) controllers.

3. **Motor encoder:** Using customized PIDF controllers for the motor, **we managed to sustain the desired position and be reliably set in the autonomous and teleoperated periods.**

Learning:

We learned that the more sensors the robot has to assist the drivers, the easier it is for them to focus on the strategy and the more consistent the robot is.

Engineering (Programming)

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Key algorithms:

PIDF

We use it to control the **position** of the robot and its elements, avoiding oscilations or unexpected movements. By using the robot's current position in relation to the desired position, along with **derivative, integral, and feedforward adjustments,** the robot can reach its target **quickly** and **efficiently.**

State machine

Our robot moves its mechanisms and follows trajectories **synchronously** during the autonomous phase, thanks to the fact that this element executes all commands according to its current state in the competition. Some of the states we use are **"INTAKING," "CLIMBING," "TRANSFERING,"** and others.

Dead wheels

Along with the coordinates of the initial position, the robot can be **precisely** located on a 128x128 Cartesian plane, allowing it to **self-correct** in autonomous mode in the event of a collision.

Climber

Along with the state machines, we use a **tick limiter** for our climber system. This **prevents** this element from **rising** above a certain height to **prevent long-term damage.**

Field Centric Drive

By using the **IMU** to calculate the current angle, we can make the robot's controls **independent** of its **relative angle.** This way, it can move forward **no matter where the robot is facing.**

Speed in X:
cos(Δangle) × Joystick Y
- sin(Δangle) × Joystick X

Speed in Y:
sin(Δangle) × Joystick Y
- cos(Δangle) × Joystick X

Classes Diagram (UML)

Outake

- rotationOutakeR/L: Servo
- garraOutake: Servo
- brazoOutakeR/L: Servo
- munecaOutake: Servo

+ void setRotation(position)
+ void setBrazo (position)
+ void setGarra(position)
+ void setMuneca(offset)
+ void init()

Climber

- pK: int, iK: int, dK: int
- motor1 : Motor
- motor2: Motor

+ void init()
+ void setMotorMode(RunMode)
+ void updatePID(target)
+ int getSlidePos()

TeleOp

- RobotState: enum
- intake: Intake
- outake: Outake
- climber: Climber
- mecanumDrive: Drive
- timer: ElapsedTime

- void update()

Intake

- pK: int, iK: int, dK: int
- rotationIntakeR/L: Servo
- garraIntake: Servo
- brazoIntake: Motor
- munecaIntake: Servo
- limelight: Limelight3A

+ void init()
+ void setMotorMode(RunMode)
+ void updatePID(target)
+ void setRotation(position)
+ void setBrazo (position)
+ void setGarra(position)
+ void setMuneca(offset)
+ void rotateWithCamera()

Drive

- inPerTick: int
- kS: double, kV: double, kA: double
- leftFront: Motor
- leftRear: Motor
- rightFront: Motor
- rightRear: Motor
- voltageSensor: VoltageSensor
- imu: IMU
- par: Encoder, perp: Encoder

+ void setDriverPowers(powers)
+ class FollowTrajectory(Action)

Controls diagram

Acknowledgements

We would like to take this space to **thank everyone who has been part of this journey.** First of all, our **mentors** who with much **love and commitment** founded this team, which today we can call a **family**. They **motivate and inspire us** to move forward, despite the complications that may arise. We are very grateful to have them **share their legacy with us** and to be able to learn from their experiences.

We also want to thank Vic, our coach, for **believing in us and for never letting go.** We are very happy that he decided to join this family, his support has been **fundamental to achieve our goals** during this season.

We are sure that **Hype-Birds** would not be the same without the commitment and dedication of each one of the people who **are and were** part of this team. We grow thanks to **everyone's effort**.

For that and more, we say **THANK YOU** for making history with us. We want you to know that we treasure every moment we lived together and that every story told **will always be part of Hype's identity.** We are glad each of you that you are part of it as well.

Together we will fly higher!

Hype Birds 16818

With love, Hype-Birds members of the 2024-2025 season.