LEBOB 2955O

PRESENTS



SHELOB

BIO BUZZ 2026 - 2027 | WA QUALIFIER

POWERED BY

Palantir WARES DNA RACING

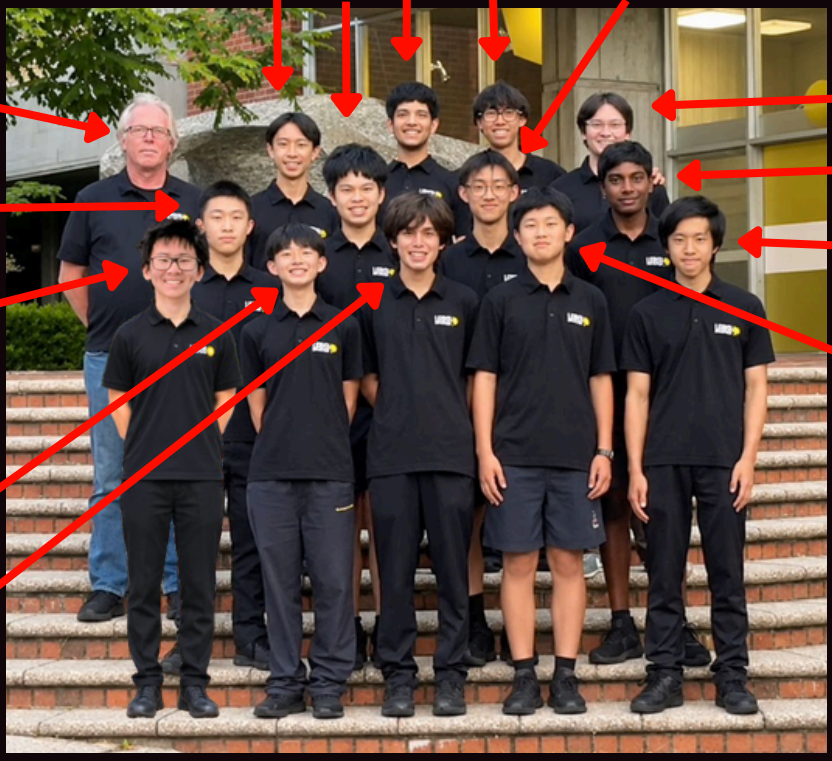
01 Introduction

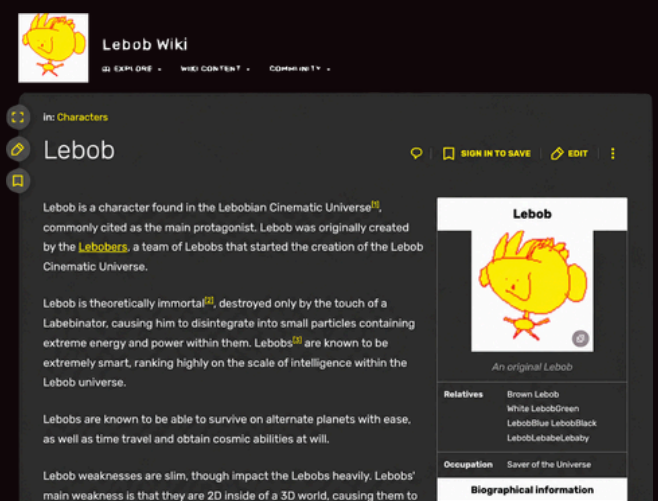
WHO IS TEAM LEBOB?

Lebob is an independent, not-for-profit robotics team based in Perth, Western Australia. Lebob competes in FIRST Tech Challenge as team #29550, with our team competing in our 1st FTC event. Lebob is not a school team but most of our members attend Perth Modern School. We started Lebob ourselves and run it under Lebob Robotics, an unincorporated not-for-profit association with its own ABN. Lebob enters competitions independently and raises our own sponsorship.

Lebob is entirely student-led, with members leading and managing meetings, projects, and team goals. This structure encourages leadership, personal growth, and accountability within lebob. Our mentors help with providing expertise, discovering them through engineering endeavours and connections.

OUR TEAM





Lebob even has a movie!

A unique feature of our team is the mascot, Lebob, featuring in a fantastical cinematic universe. An entire wiki fandom consists of foretelling facts and concepts related to the characters that live within this universe. All the characters within this website reflect the creativity and fun exploration of our team!

02 Finance

SUMMARY OF TEAM BUDGET

MACRO	AREA	DETAIL	ORGANISATION	Estimate pp (incl GST)	Estimate (Actual) (incl GST)	subtotal	Actual (incl. GST)
SEASON	Registration	Team registration + regional qualifier + Nationals entry - PAID	FIRST Australia		$413.00		$413.00
SEASON	**subtotal**					***$413.00***	
SEASON	Robot	Robot build (custom)	goBILDA / Core Electronics		$6,000.00		$4,930.71
SEASON	Robot	REV DRIVER HUB	REV		$400.00		$411.90
SEASON	**subtotal**					***$6,400.00***	
SEASON	Field	Game pieces + elements (at cost)	via Harry, FTC WA		$1,100.00		
SEASON	Field	Field elements - tiles, perimeter	Bunnings		$450.00		$100.00
SEASON	**subtotal**					***$1,550.00***	
SEASON	Consumables	Spares, US freight, import GST and customs	REV / goBILDA		$600.00		
SEASON	**subtotal**					***$600.00***	
SEASON	Workshop	Tools and consumables - optional, in-kind target			$1,000.00		
SEASON	**subtotal**					***$1,000.00***	
SEASON	Marketing	Shirts (Parents or In-Kind)			$850.00		
		Pit Banner + Sponsor Board					
SEASON	Marketing	Engineering portfolio printing and binding			$125.00		
SEASON	**subtotal**					***$975.00***	
SEASON	Software	2 non-profit claude premium seats, 3 months (US$40/seat/mo) +tax			$378.00		$66.00
SEASON	**subtotal**					***$378.00***	
OUTREACH	Team Support	Support direct teams Jade and leboblets team			$2,000.00		
OUTREACH	Team Support	Support Team 4788	FTC 4788		$1,000.00		
OUTREACH	**subtotal**					***$3,000.00***	
OUTREACH	Schools	Establish school robotics program	Wellard Village Primary		$1,000.00		
OUTREACH	**subtotal**					***$1,000.00***	

SPENDING

Lebob has made sure to carefully budget our allocated and sponsored earnings in order to inform our sponsors and track spending. This allows us to know where significant costs go and where we can further distribute money to improve our robot and help provide outreach.

SPONSORS

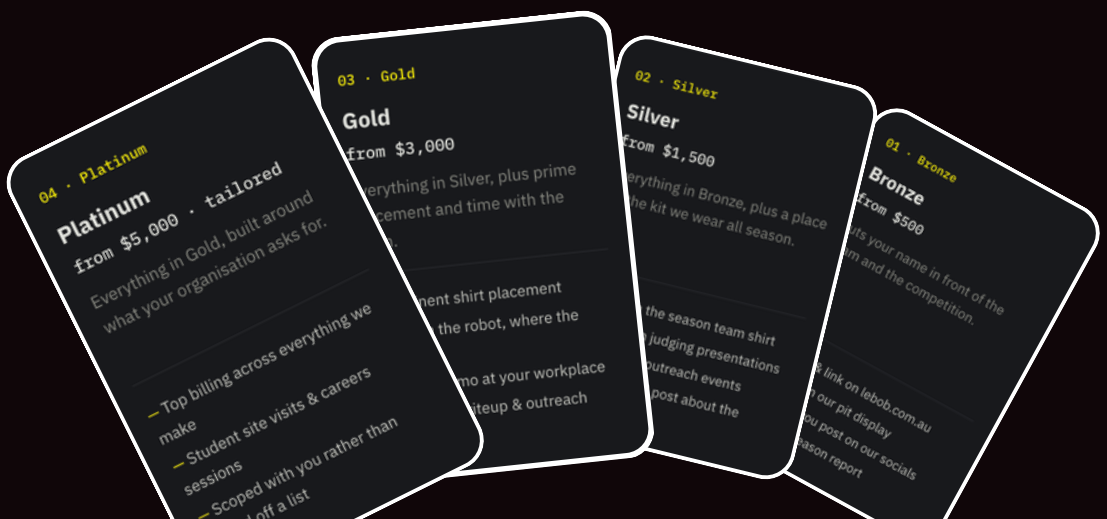
Our team is very thankful for our gracious sponsors. We secured these sponsors through the hard work of our team members. We have achieved these sponsors through making connections at outreach events, emailing, and developing an extensive sponsorship packet. Our sponsors recognize the passion and drive our team has!

SPONSORSHIP TIERLIST

Our team developed many sponsorship packages, using a tier-list to determine the perks for our sponsors. This gives our sponsors a clear vision of what they will receive by supporting us.

TEAM CONTRIBUTION

Other than external provided funds, members of our team assist our progress through indirect cash spending on 3D prints, personal machinery and equipment.



Palantir

WARES

DNA RACING

03 Outreach

Robotics Stall!

PERTH ROYAL SHOW

Five of the Lebob members involved themselves at a robotics stall at the annual Perth Royal Show. This was done as part of an initiative with Curtin University, who partnered with the Department of Primary Industries and Regional Development (DPIRD) and Murdoch University to inspire those coming to the stall to do robotics, with a free robot driving session.

This day helped the next generation of students and children participate in simple robotics and gain insight into its variety of opportunities and depth which they can partake in, including all ages. Although it didn't directly influence our FTC robot and chances of winning, it meant that we could help others discover untouched career opportunities and personal interests.













SCHOOL SHOWCASE

Another initiative by Lebob was a robot showcase at Perth Modern School. With permission from teachers, we organised a session for Year 7 students to introduce them to STEM by showcasing one of our FRC robots. Students were given the opportunity to drive the robot in a classroom environment and interact with the team by asking questions about its mechanisms, engineering decisions and design process. This provided students with a workshop style introduction to robotics while encouraging their engagement in robotics and showcasing the opportunities available through FIRST programs.

GITHUB OPEN SOURCE

As part of plan to support and encourage other robotics teams, Team Lebob maintains an open source GitHub repository where anyone can access our FIRST competition resources, documentation and code. By making these materials publicly available, we aim to help upcoming teams get started, learn from our previous experiences and understand how we structure our programming and competition preparation. We believe that sharing our knowledge and resources helps strengthen the wider robotics community and makes STEM more accessible to everyone.

04 Sustain

SCHOOL PROGRAM

Team Lebob aims to establish a long term outreach program within the Kwinana community, focusing on introducing school students to the fundamentals of robotics.

- interactive workshops
- robot demonstrations
- hands on activities

We hope to inspire younger generations to explore engineering and develop an interest in STEM beyond the classroom.

By making robotics accessible to students from diverse backgrounds, we aim to encourage greater participation in STEM and build stronger connections between young people, educators, and engineering professionals.

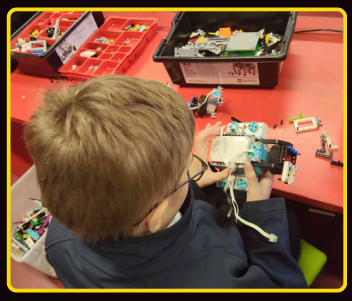
By collaborating with local schools, we plan to introduce students to FIRST programs, including FIRST LEGO League (FLL) and FIRST Tech Challenge (FTC). Through mentorship and ongoing support, we aim to help schools establish their own robotics initiatives, creating opportunities for students to develop technical skills,`` and problem-solving abilities.

Our long term vision is to create a sustainable cycle of STEM education. By establishing community partnerships and supporting the growth of FIRST programs, we hope to contribute to the robotics community and a strong future for engineering in Kwinana and eventually the entirely of Western Australia.

Kwinana Program!

MENTORING FIRST TEAMS









Lebob not only competes in FIRST competitions, but also mentors future teams to continue our legacy. Meet Leboblets, a team Lebob mentors and supports throughout their journey in FIRST. They are currently competing in First Lego League in the 2026/27 BIOGLOW season.

Lebob does not directly complete the season for Leboblets, but rather supports them through our extensive experience by providing feedback and judging analysis we have come across through several years of competing. By starting Leboblets, we have helped intriduce them to STEM and encouraged this through the facillitation of FIRST.

Furthermore, Lebob members provide mentorships voluntarily to teams at Aquinas College. Providing them with Lebob's resources has allowed them to prepare for their FLL competitions this year.

05 Experts

PALANTIR

A major accomplishment in the season was the meeting with Palantir employees, receiving the opportunity to communicate and learn from their experience in the AI industry and knowledge in software.

Initially we began with the decisions we need to make at the WA Qualifier, with which matches matter most for our ranking point goals, what score we need, and which alliance partner categories complement our robot's strengths.

For each match, we want to compare the teams autonomous plans and scoring, teleop output, consistency and reliability, and then use that evidence to estimate the likely score and win chance.



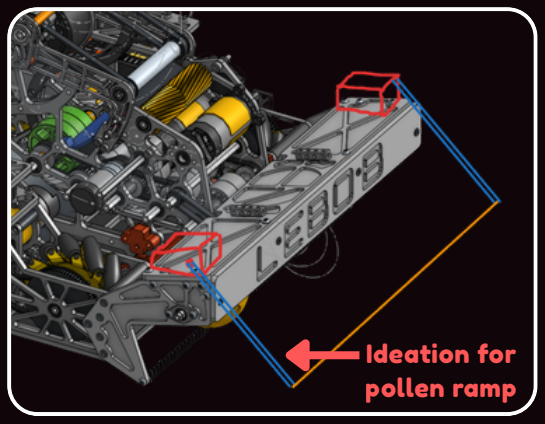
Andrè, a member of our team

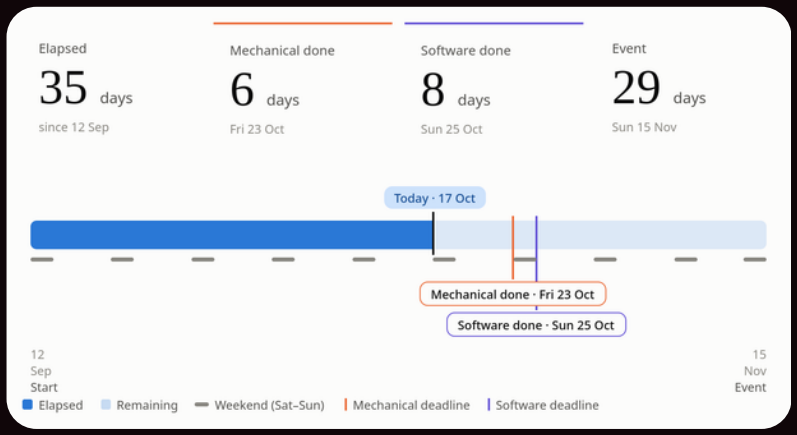
Refer to page 14 for more information about the development of the Foundry and Scouting App which assists us with the goals established in this session.

CURTIN ENGINEERS

Throughout our development, we sought guidance curtin professionals to ensure that our engineering decisions remained practical and aligned with our competition goals. Their involvement extended beyond simply providing technical advice, as they regularly reviewed our designs, questioned our assumptions and offered valuable feedback on potential improvements.

They also helped us monitor our development timeline, identify priorities and ensure that we remained on track to meet important milestones before the regionals competition. By incorporating their feedback into our development process, we were able to make more informed decisions, use our limited time more effectively and maintain a clearer direction throughout the season.





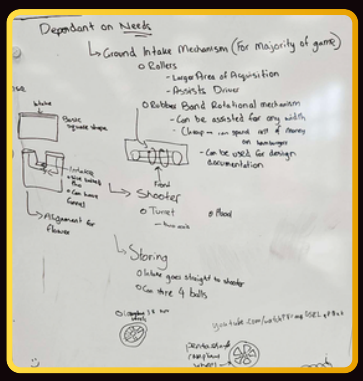
06 Planning

Season Groundwork

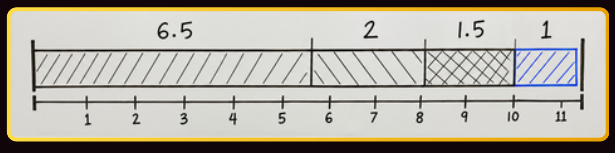
During our first sessions, we listed out all processes in the game, such as scoring, intaking, and parking. Then, we discussed and chose as a team which tasks were essential, preferred, and unnecessary (Need, Want, and Don't). This narrowed our scope and established what tasks to focus within our limited timeframe. Afterwards, we made a hierarchy of the remaining "want" tasks, allowing us to focus on the more important mechanisms first. To make the tasks more specific, we added Key Performance Indicators for every task, creating a way to measure success in the future.

Game Element		Description	Decision	Priority	KPIs
General		DRIVE	Need		speed (m/s), intuitive (how well can driver drive with controller)
		LEAVE STARTING AREA during AUTO	Need		consistency (percentage)
		PARK in LOADING ZONE during AUTO	Need		consistency (percentage), time (seconds),
		PARK in LOADING ZONE during TELEOP	Need		consistency (percentage), time (seconds),
		DEFEND (any capacity)	Want	Mid	instantaneous impact (force)
		DRIVE through robot-to-robot contact	Want	High	displacement (meters), accuracy during defence (%)
	POLLEN	COLLECT POLLEN from ground	Need		rate (balls per second), consistancy/accuracy/reliable (%)
		COLLECT POLLEN near HIVE	Need		rate (balls per second), consistancy/accuracy/reliable (%)
		COLLECT POLLEN released from HIVE	Need		rate (balls per second), consistancy/accuracy/reliable (%)
		STORE POLLEN	Need		amount (balls)
		EJECT POLLEN	Want	Low	speed (balls per second), simple (complexity)
		INDEX POLLEN	Want	Low	reliability (%),
		SCORE POLLEN in HIVE	Need		speed (balls per second, accuracy/reliability (%)
		SCORE POLLEN in FLOWER	Don't		

The team then split up into smaller groups and brainstormed mechanisms to incorporate. Once finished, we pooled our ideas and extracted the key strengths and merged together to create the ideal robot. This led to several healthy debates on intake types, drive base shapes, shooters, and storing possibilities. Although we didn't lock in the final design, we were able to eliminate possibilities that either wouldn't work well or not worth the time.



Cycle time analysis: Our Target was approximately 13 total cycles, achieving 7 tips and obtain 2 ranking points. The proposed breakdown was 11 cycles during teleop, 5.5 seconds to collect fuel, 2 seconds to return and place, 1.5 seconds to align and 1 second to shoot, giving a target of 10 seconds per cycle.



Summary:

- Pollen-shooting robot
- Ground intake
- Not prioritising flower
- Speed-focused autonomous routine
- Mecanum drive
- Potential two-wide pollen shooter.

Nectar and pollen or purely pollen robot?

We split into two halves, discussing between ourselves. Both teams came decided to get rid of nectar indexing and choosing to be a fast pollen launching robot. This is because being really good at one task is better than being decent at multiple.

Possible post-Regionals development: Potentially for Nationals, the team may add a pick and place mechanism for nectar, depending on time, performance and strategic value.

07 Designing

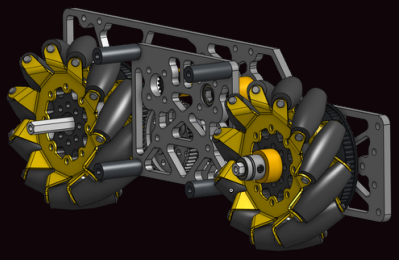
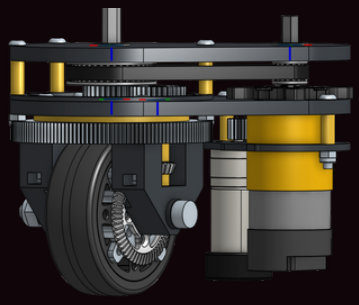
Comparison of mechanisms

As our designing progressed, we became more focused on evaluating the practicality of different mechanisms rather than simply their potential performance. We considered factors such as reliability, complexity and how each mechanism contributed to our competition strategy.

One major discussion involved choosing between a single lane and double lane pollen shooter. Although a double lane design could potentially increase shooting speed and decrease indexing area, but it also introduced greater complexity, maintenance and potential reliability issues. We ultimately selected a single lane hooded shooter because it offered greater accuracy, consistency and simplicity within our timeframe.

We also explored improvements to our intake system, including the use of vector wheels to improve pollen collection. Additionally, we considered a ramp mechanism that could prevent pollen from spilling out while potentially obstructing opponents' shooting paths. This encouraged us to think beyond individual functions and consider how mechanisms could serve multiple purposes in the competition.

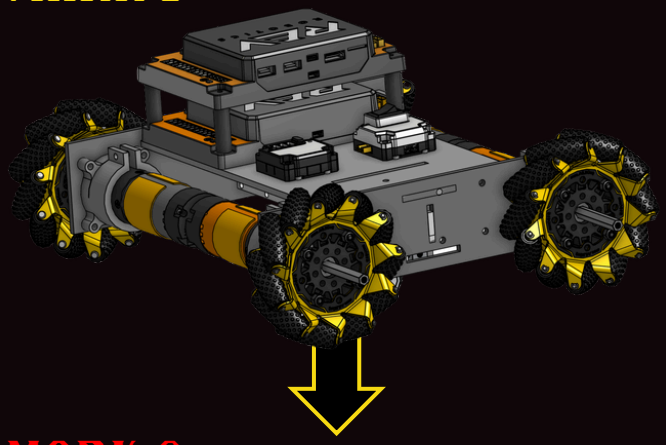
Our drivetrain concepts also evolved as we considered the advantages and disadvantages of mecanum and swerve drive. We recognised the trade offs between manoeuvrability, mechanical complexity and reliability, placing greater importance on developing a stable and effective system rather than introducing unnecessary features.

MECANUM 	**Advantages:** • Compared to other drives and linkages, mecanum is relatively straightforward to design and can be bought of the shelf. • Four independently powered mecanum wheels let the robot slide sideways, move diagonally, and spin simultaneously. • Allows the robot to strafe without having to do multi-point turns.	**Disadvantages:** • With a mecanum drive, there is an increased risk of slipping. • Due to the slipping, other drives with high traction can easily push the robot.
SWERVE 	**Advantages:** • Uncompromised pushing power (high traction) which provides high resistance against friendly shoving. • Allows robot to drive in any direction while translating. • Swerve doesn't have heavy drifting and the solid grip of swerve traction wheels has more consistent wheel encoder feedback.	**Disadvantages:** • A major limit of swerve in FTC is the motor limit of 8, as typical swerve systems require 8 motors and 8 servos (4 for driving and 4 for rotation). • Also fitting 4 swerve bevel gears can be difficult in the robot size limit. • A swerve drive is complicated to create and program.

08 SHELOB

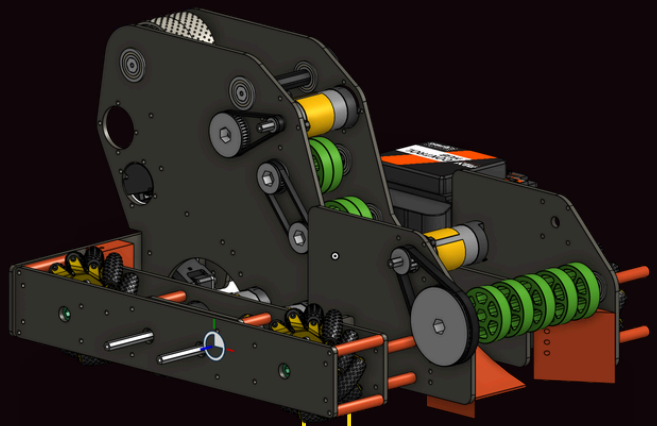
1 Ideate 2 Design 3 Build 4 Test

MARK 1



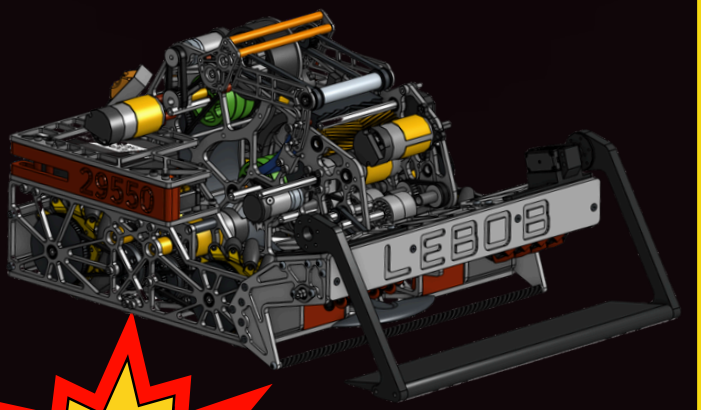
Prior to the season, we started modelling a basic drivebase on onshape, allowing us to test new wheels, and connect it to a controller to check whether every component was functioning properly. The Mark 1 robot was far from perfect with minimal wire management and lots of tape but provided us with a good base to configure our components and determine relative movement.

MARK 2



For our mark 2 robot, we modelled an intake and shooter with carboard plates. This allowed us to test out different materials and mechanisms to improve on. We found that the intake could've been widened and the shooter could only shoot from one position on the field. We also tested the motors to experiment with different speeds and roller sizes. Also, this design provided us with the necessary testing for our indexing with the s shape design of the ball path.

MARK 3



Our Mark 3 robot is the final iteration which we will use for regionals FTC competition. It includes machine cut sections of metal for our drivetrain and better material components for structural integrity. We also improved the intake by make it the full width of the robot, and created a mechanism to rotate the angle of the shooter, allowing us to shoot from almost any position on the game field. We also incorporated a flower pollen ramp for another access to pollen. A key part of the mark 2 we kept was the ball path.

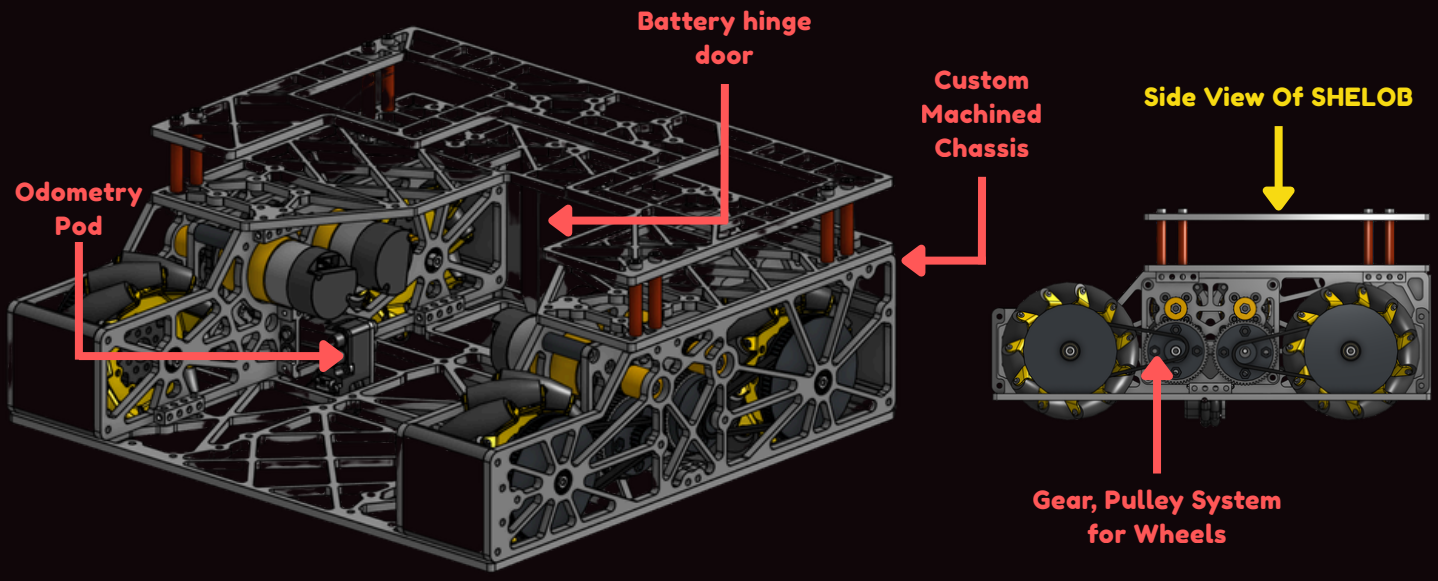
Ideation!

09 Drivebase

Pocketing was used on the drivebase plates to remove excess material and decrease weight. This makes our robot faster and lighter. We made the mistake of not having a solid channel through the middle of the robot, which caused the ball to get stuck inside the pocketing of the bottom plate. To fix this, we added a long plastic sheet, allowing the ball to move through smoothly. For our wheels, we calculated the optimal belt and pulley ratios for the right balance between speed and torque.

We also made sure that the drivebase pocketing and extruding screws did not interfere other subsystems, for example we left a large gap in the middle for the indexer to fit and checked that everything fit correctly before building the robot.

We added a hinge inside of the robot rear to make the battery more accessible for use and safer from other robots and hitting walls.



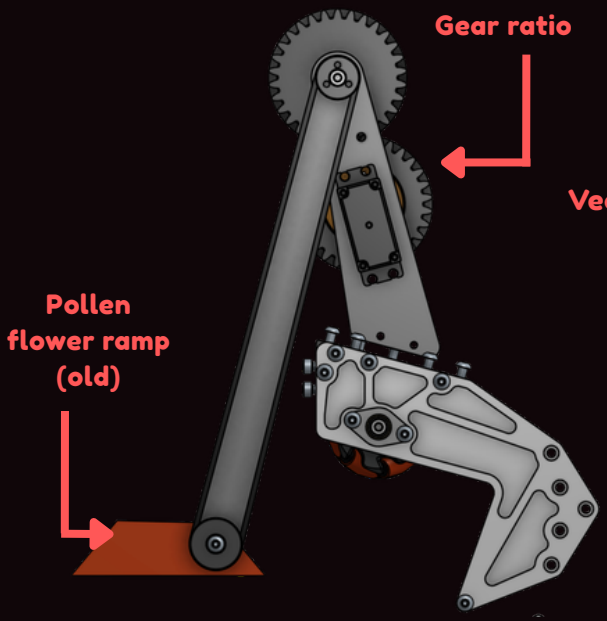
Furthermore, an Odometry pod was mounted below the motors and was connected to an omni wheel, this allowed us to calculate the shooting angle needed to score in the hive from almost any angle as well as generally improving auto accuracy.

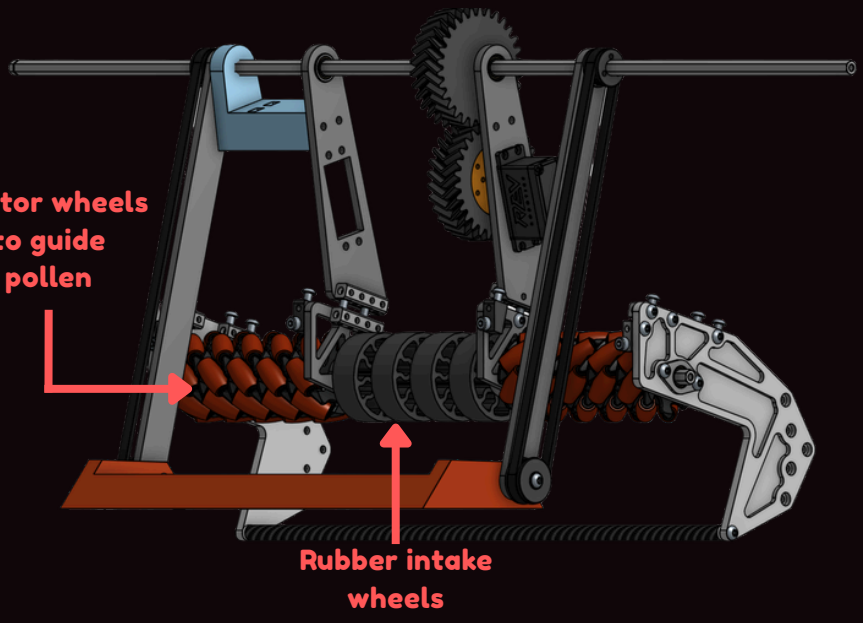
Our mark 1 robot was purely a drivebase without consideration of the other systems, allowing us to test our wheels. Mark 2 drivebase had roughly the right parameters and wheel locations, however we did not have pocketing and proper spacers, which reduced its structural integrity and made it harder to wire.

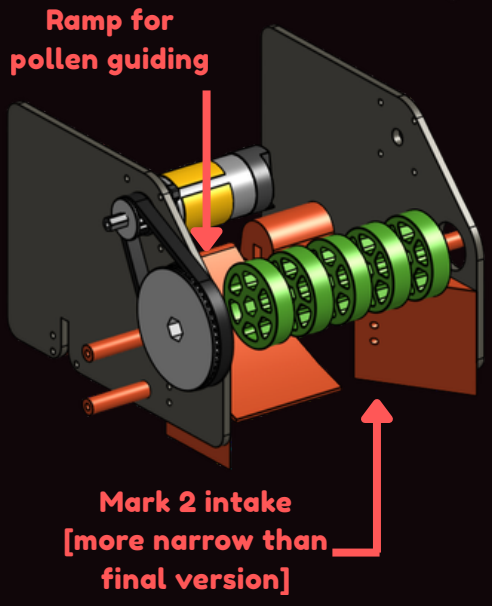
```
{
    var pitch; // Tooth Pitch
    var innerOff; // Inner Offset From Pitch Line
    var outerOff; // Outer Offset From Pitch Line
    var pld; // Pitch Line Differential (pitch line down to pulley OD)
    var odOff; // Amount Subtracted From Pitch Diameter To Get Pulley OD (normally 2 * pld)
    var edgeRad; // Groove Edge Radius
    var toothConfig; // Value Passed To The TOOTH Part Studio's "pitch" Configuration
    var beltName; // Belt Name Ex: HTD5
    if (definition.pitch == Pitch.HTD5)
    {
        pitch = 5 * millimeter;
        innerOff = 2.93 * millimeter;
        outerOff = (3.8 - 2.93) * millimeter; // Belt thickness 3.8mm
        pld = .87 * millimeter;
        odOff = 1.144 * millimeter; // Unchanged from the original hard-coded value
        edgeRad = 0.43 * millimeter;
        toothConfig = "htd";
        beltName = "HTD5";
    }
    else if (definition.pitch == Pitch.HTD3)
    {
        pitch = 3 * millimeter;
        innerOff = 1.551 * millimeter; // PLD (0.381) + belt tooth height (1.17)
        outerOff = (2.4 - 1.551) * millimeter; // Belt thickness 2.4mm
        pld = 0.381 * millimeter; // HTD 3M pitch line differential
        odOff = 0.762 * millimeter; // 2 * pld
        edgeRad = 0.26 * millimeter; // HTD 5M groove edge radius scaled by 3/5
        toothConfig = "htd3"; // Must exist in the TOOTH part studio's "pitch" configuration
        beltName = "HTD3";
    }
```

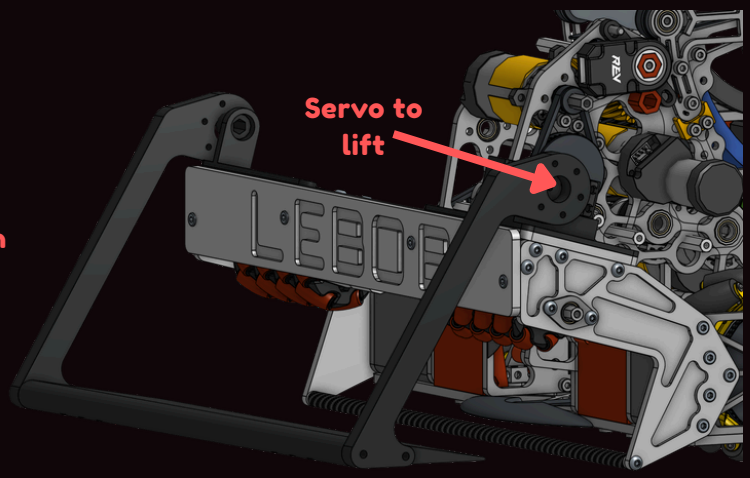
CAD Featurescript including calculations for various belts and pulleys across build

10 Intake







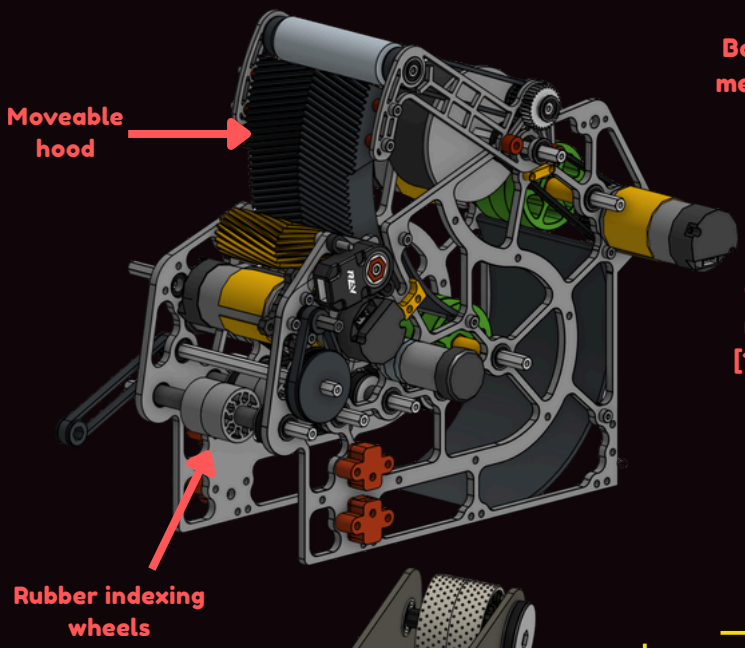


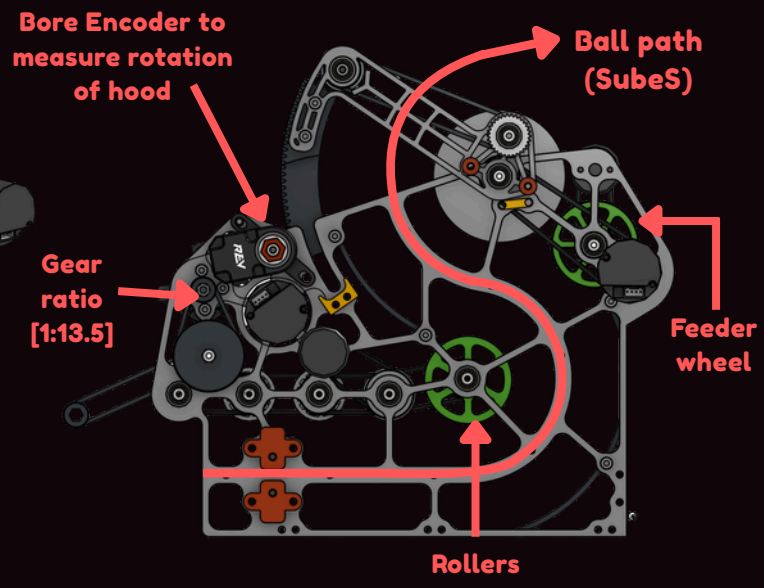
For our first intake, we had a skinny channel with rubber rollers and 3d printed guides for the balls. We found that it was extremely difficult to align the pollen to pick it up, so we tackled this problem by widening the intake to the full length of the drivebase.

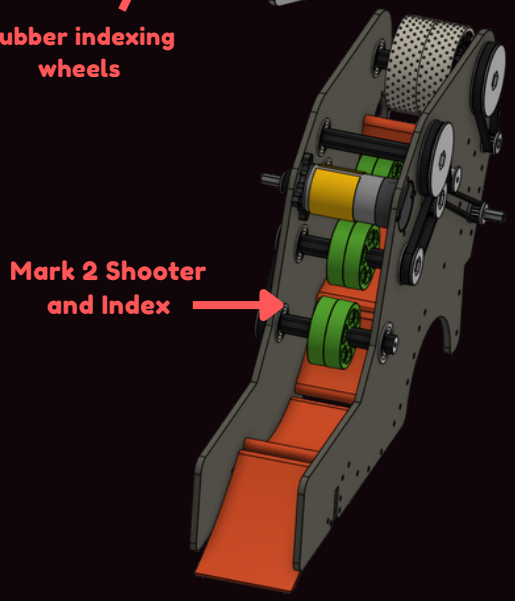
However, another problem arose from this - having a wider intake caused the balls to often get stuck on void space on the side of the previous rubber rollers. To fix this, we switched our outer rollers for small vector wheels, which would guide the balls towards the middle ball path for indexing.

A feature of our intake was a additional pollen ramp as alternative form of pollen that we could use for faster cycle times or as a backup, which would lead to more match points and overall better chance at winning. By driving into the flowers, the ramp tilts in a way so that the pollen drops down and slides right into our intake.

11 Shooter







Team Lebob used an encoder to track and adjust the shooter hood so we can have a reliable and consistent launch angle. The encoder allows us to adjust shooting by providing us with data to find how much power we should use for each angle, allowing us to have a robot shooting from multiple different positions.

The ball path shape was kept similar from mark 2 for mark 3. A change was that we incorporated a hood and lowered the height of the shooter so we have a smaller ball path. The main idea of the ball path was to maintain contact with the pollen throughout the entire robot through rollers.

Our ball path starts with grey rollers that carry the ball up our ‘S’ shaped curve. In the middle of the curve, we have a feeder wheel that rotates the opposite direction, preventing shooting while the robot is still driving around. When we need to shoot, the feeder wheel then spins the other direction, allowing the pollen to continue. However, one major issue we encountered was excess compression of the pollen near the top. This led to motors stalling and pollens getting damaged in an attempt to spew out the balls. We fixed this by redesigning the hood and adding a flywheel.

Indexing for mark 3 (Shelob) consisted of a channel with 1.5 pollen width approximately that got narrowed to 1.1 pollen width when reaching the top. We incorporated railing to stop the pollen from interacting with the pulley system within the intake.

12 Drivetrain



An important aspect of our drivetrain was transferring power from the motors to the wheels efficiently. We incorporated a geared transmission system, allowing the motors to drive the wheels while maintaining a compact arrangement within the chassis. The positioning of these components was carefully considered to accommodate the drivetrain hardware without interfering with the surrounding mechanisms.

We also considered motor efficiency when selecting our components, eventually opting for bare motors for the drivetrain. This decision was intended to improve the efficiency of our powertrain while maintaining the performance required for competition. Integrating the motors and gearing within the chassis required careful consideration of mounting positions, alignment and available space.



The drivetrain transfers power from the motors through geared transmissions to the wheel axles. The gear reduction provides the torque needed to accelerate and turn the robot, while independent motor control lets us adjust each wheel’s speed. We tested the system under load and tuned the gearing and control settings for reliable movement.

The arrangement of the drivetrain components allowed us to integrate the power transmission system into the overall chassis design, creating a compact assembly that could support the robot's movement and manoeuvrability.

13 Software

CODE

- Java (Gradle) using FTCRobotController
- Ordered into subsystems, util and hardware
- Structure similar to FRC programming

Shoot on the move

Lebob uses a precalculated table to determine hood angle and shooter RPM quickly based on where the hive is.

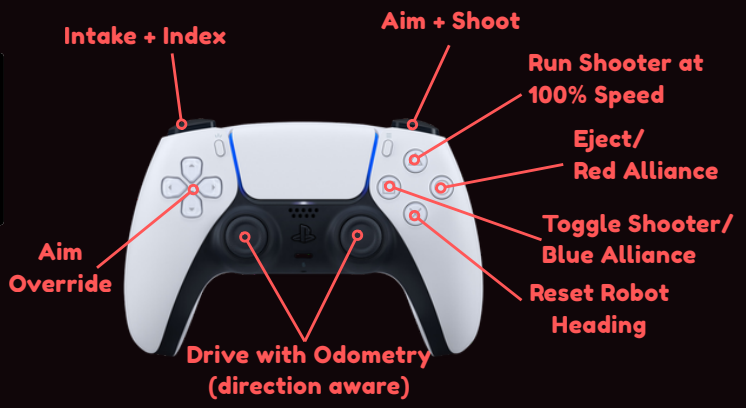
01 – By simulating the physics of the ball 01 – after being shot, we could predict its 01 – trajectory based on different hood angles 01 – and shooter RPM values. This simulation 01 – used values from CAD, BIOBUZZ 01 – documentation, practical testing e.g. air 01 – resistance.

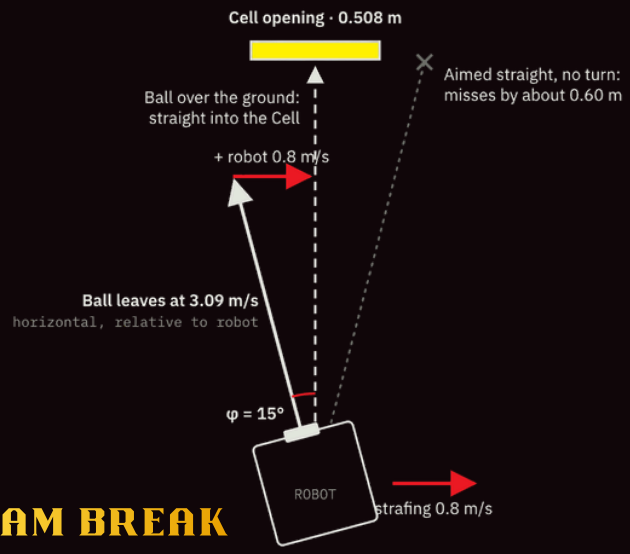
01 – The code evaluates possible robot 01 – positions and velocities, trying hood 01 – angles and shooter RPMs to test whether 01 – the shot is successful. It groups shots 01 – with similar inputs to establish a 01 – tolerance, allowing for slight variations 01 – in hood angle or RPM while still achieving 01 – a successful shot.It then determines the 01 – best shot and puts it into the 01 – precalculated table.

03 – The robot uses odometry and vision to 01 – determine its position and velocity. Then 01 – it uses the precalculated table to 01 – determine optimal hood angle and shooter 01 – RPM, interpolating between nearby values 01 – if needed. If there is a valid shot it 01 – will then attempt a shot.

04 – The robot will continuously reference the precalculated table to adjust the shooter RPM and hood angle. Once the RPM is within approximately 50 of the target and the hood angle is within 2 degrees, it activates the indexer to begin shooting. It also adjusts its rotation to oppose its tangent velocity, compensating for sideways movement so the ball maintains its intended trajectory into the hive. The driver retains control of the robot's movement while the shooting system automatically adjusts to the required settings.

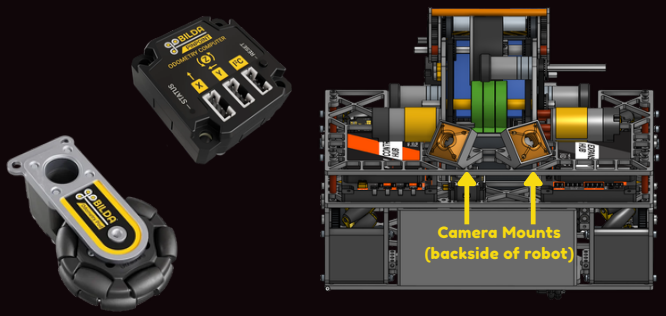
TELEOP CONTROLS





BEAM BREAK

Beam break is located between intake and indexer. It is placed there so we can locate when we have 4 balls so it ensures that the shooter wheel never tries to launch pollen before the flywheel reaches target RPM, preventing missed or short shots.



ODOMETRY

We use a combination of both cameras and pinpoint so that our robot knows where it is at all times. (odometry)

14 Software

AUTONOMOUS

When tuning our shooter, we implemented a **different version** of the code to allow for faster and more efficient tuning. The code uses odometry to **automatically go to shot locations**, and shoots balls one at a time, and a **human observer provides feedback** using controller buttons to adjust the shot.

We decided to have multiple autos that can be picked based on our situation. We have two types:

- Push auto
- Scoring auto

These are programmed in code using Pedro Pathing.

TUNING CONTROLS

When tuning our shooter, we implemented a **different version** of the code to allow for faster and more efficient tuning. The code uses odometry to **automatically go to shot locations**, and shoots balls one at a time, and a **human observer provides feedback** using controller buttons to adjust the shot.



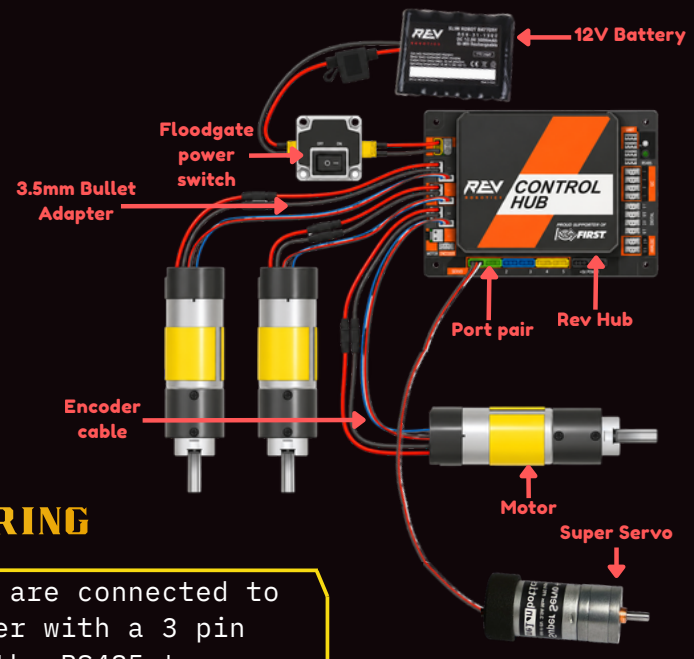
14 Electrical

BEAM BREAK

We used a beam break sensor to prevent over possesion and count how many balls the robot has.

CAMERAS

The cameras wire into the Control Hub's USB ports. However, initially we used the usb cable to connect the Control and Expansion Hub, so we switched to the RS485 ports to connect both our cameras



PIN POINT

The two odometry pods for the x and y axis are connected to pinpoint IMU, and the IMU connects to the REV hub's I2C port.

HUB WIRING

The hubs are connected to each other with a 3 pin wire on the RS485 to improve robustness of the connection during the match.

15 AIP Foundry

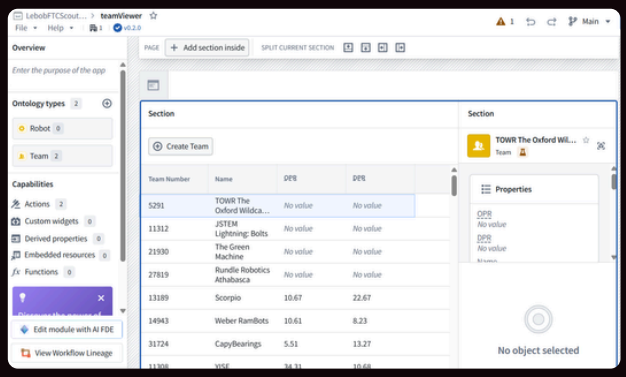
An API Foundry is a developer friendly REST (Representational State Transfer) API that allows external scripts, tools, and non-Foundry applications to programmatically interact with and build upon Palantir's Palantir Foundry platform.

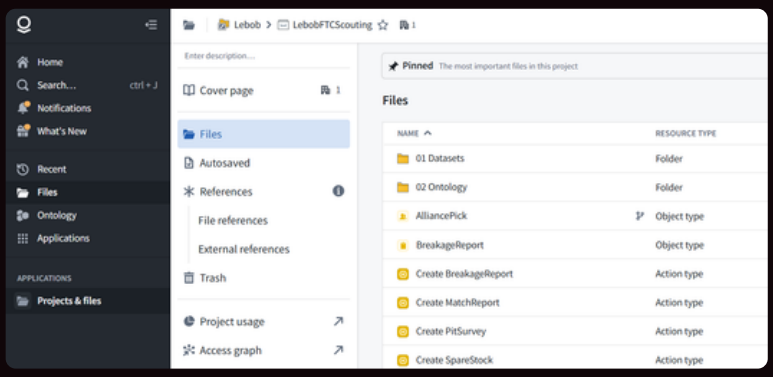
Our plan is to use the official FIRST API for team and match information, then add our own scouting data such as autonomous paths and consistency, scoring and cycle times, preferred routes or zones, reliability, defence, penalties and breakdowns. These insights can help us decide how to use our robot and work with our alliance partner.

A key distinction to note is that Foundry supports our decision making but it doesn't control the robot, and the team ultimately makes the final strategy choices. We prefer to make and understand our own calculations rather than rely on an imported rating as a black box.

Intended Workflow

01 — Import and check competition data
02 — Enter scouting observations
03 — Link data to teams and matches
04 — Calculate useful summaries
05 — Display the results in the app's match cards and event views.





15 Scouting App

Lebob Scout is an offline, phone friendly app for collecting match, pit and robot breakage scouting data at events, then bringing reports together for analysis and strategy in Foundry.

Scouts enter reports on their devices, and the lead device can collect them. The current Foundry handoff is by exporting a JSON file from the lead's phone and importing it on a laptop.

Scouting App

- Match scouting: It logs match and team details, start position, autonomous and teleop actions, scoring and misses, defence, fouls, breakdowns and endgame. It also has a post-match form for observations and notes for the future.
- Pit scouting: Incorporates recording robot capabilities, drivetrain, autonomous claims, dimensions, issues and other pit observations.
- Breakage tracking: Captures failures, severity of the issue, suspected causes, recovery and repairs.
- Coverage: compares the schedule with saved match reports and flags missing or duplicate entries.