TECH BINDER

ROBO'LYON
The FIRST French Team

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01. GAME

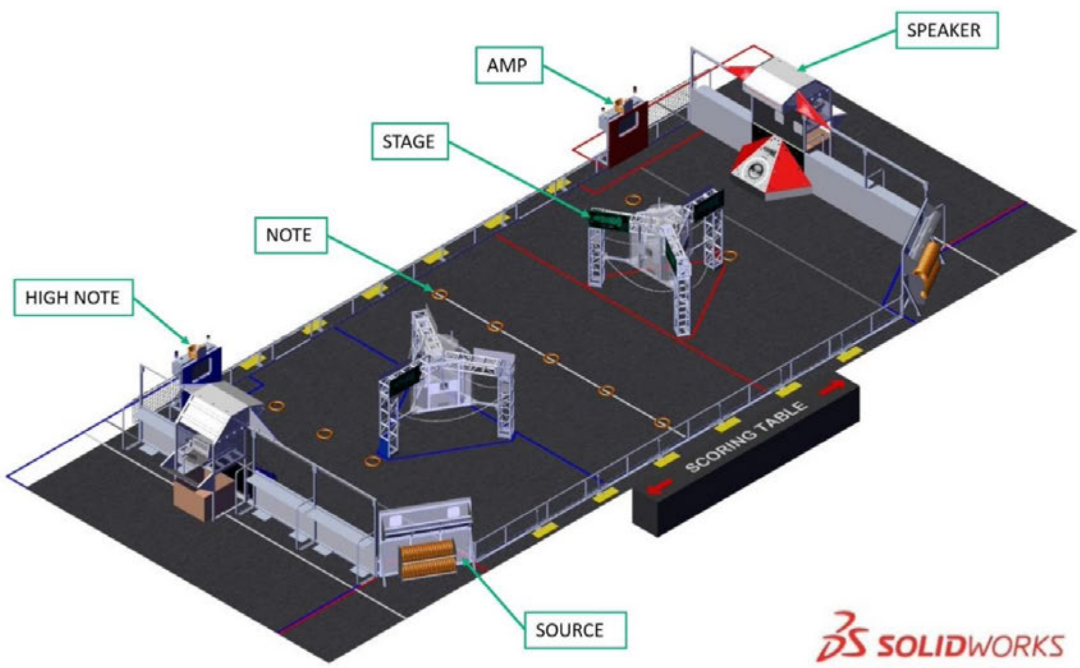
CRESCENDO

The theme of the season is FIRST In Show, and in FRC the game is about music.

In CRESCENDO two competing alliances are invited to score notes, amplify their speaker, harmonize onstage, and take the spotlight before time runs out. To win points you must

-collect the game elements (notes) on the floor or at the source
-put the notes into the amp and speaker
-hang or station yourself on the stage
-put a note in the trap.

One of the special features of this game is that if you put 3 notes in the amplifier and press the AMP button, you can recover more points in the speaker for a period of 10 seconds or until 4 notes have been scored.



SOLIDWORKS
Modeling Solutions Partner

2024 FRC GAME MANUAL

The match lasts 2min30 and is divided into 2 periods:

- **The auto period where the robot is completely autonomous, managed by programming.**
- **The teleoperated period where the robot is driven by a driver who has to collect NOTES from the source and score in the AMP and the SPEAKER.**

GAME

STRATEGY

Like every year, during kick-off the team gets together and brainstorms to analyze the game of the year. We divide into several small groups and dissect the game manual to learn the rules and:

-Analyze the different possible actions in the game and evaluate their potential in terms of points scored, enabling us to decide which mechanisms to prioritize in the design of our robot.

-Create a spreadsheet of action cycles by planning and optimizing moves to define the best strategy for maximizing our efficiency on the field.

At the same time, we create a spreadsheet of average team scores, which we'll be able to use in our Regional to help us create strategies with our future alliances.

GAME

POINTS

auto period	Move foward	2 pts
	Note in the AMP	
	Note in the speaker	5 pts
teleoperated period	Note in the AMP	1 pts
	To be on stage	
	Note in the speaker	2 pts
	Harmony (more than one robot onstage directly or indirectly)	
	On stage hanged on chain	3 pts
	To be on stage chain and spotlighted	4 pts
	Note in the speaker (amplified)	
	Note in the trap onstage	5 pts

GAME

RANKING POINTS

1 pt ENSEMBLE

When at least 10 stage points and 2 robots are hanging on the stage

2 pt WIN

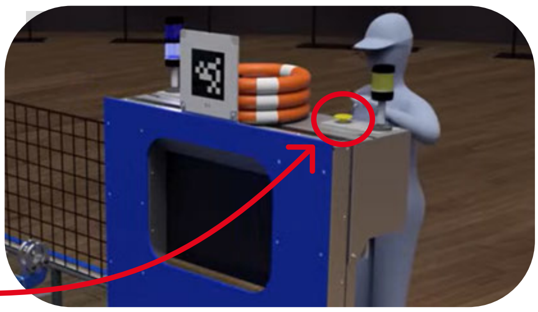
complete a match with more match points than your adversary

1 pt TIE

complete a match with same match points than your adversary

1 pt MELODY

when at least 18 points are scored in the match (reduced to 15 pts if the COOPERTITION BONUS has been activated)



coopertition button

COOPERTITION BONUS: During the first 45 seconds of the teleop period, it is possible to obtain a coopertition bonus if both alliances score in the amp and press the coopertition button. This makes it easier to win the melody ranking point, as you only need to score 15 points instead of 18 in the amp and speaker.

GAME

CYCLES AND ESTIMATED TIMINGS

Take a note from the source and place it in the amp → **1** pt -10/15 SEC-

Open the trap and place a note → **5** pts -10/15 SEC-

Take a note on the ground and shoot it into the speaker → **2** pts -4 SEC-
5pts when amplified

Move the robot from any field position to the stage and make it climb the chain → **3** pts -10 SEC-

Take a note on the ground and shoot it into the speaker (random position) → **2** pts -6/13 SEC-
5pts when amplified

Move the robot from any field position to the stage and help another robot get on stage. → **3** pts -15 SEC-

STRATEGY

This year, we wanted to build a robot able to to everything on the field.

The analysis we made during the kick-off enabled us to conclude that for the robot to be on all fronts, it had to be able to go fast, catch NOTES, shoot in the AMP, shoot in the SPEAKER and climb on the STAGE, which is why we created:

- **-a drivetrain**
- **-a shooter**
- **-an intake**
- **-a climber**

(See following pages for our strategies regarding each mechanism)

1. PROTOTYPING
2. MATERIALS
3. R&D

02. DESIGN

PROTOTYPING

We design the robot in an iterative way.

1.CONCEPTION of mechanisms in CAD.

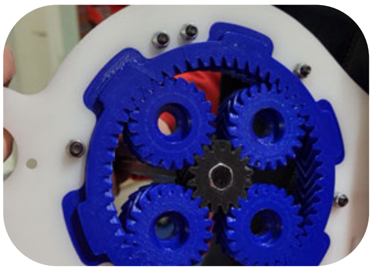
2. CONSTRUCTION of prototypes in MDF or plywood, using our CNC, to test the achievability and effectiveness of our ideas

3. IMPROVEMENT of our mechanisms.

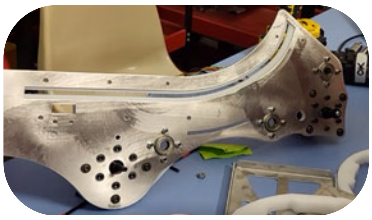
This back-and-forth process continues until we are completely satisfied with the efficiency of our robot.

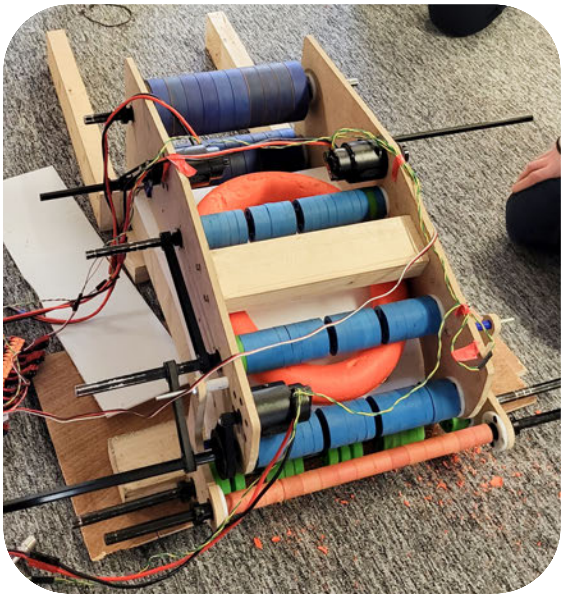
Then, the final mechanisms are machined:

We manufacture PTFE using CNC, and PETG using a 3D printer.



Our partners manufacture aluminium and steel

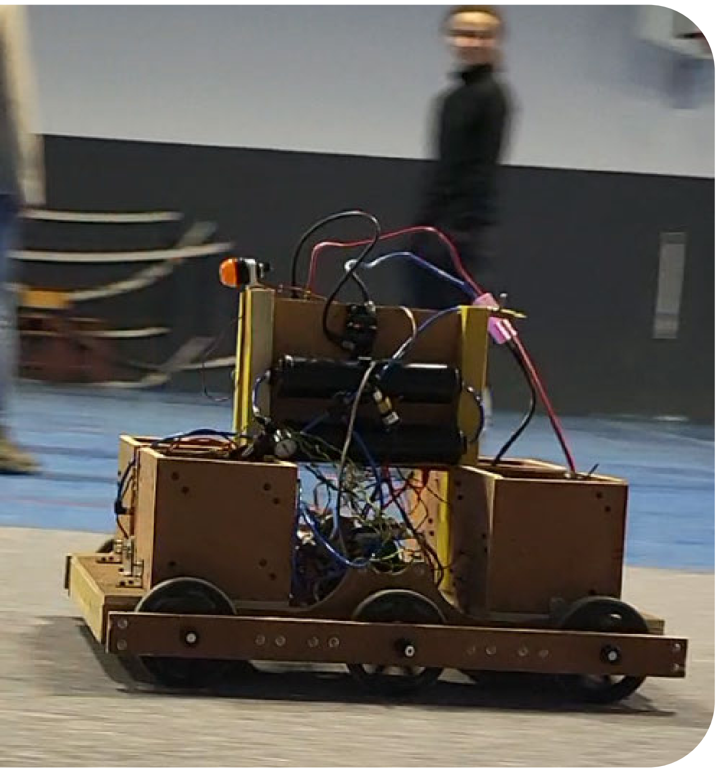




DESIGN

MATERIALS

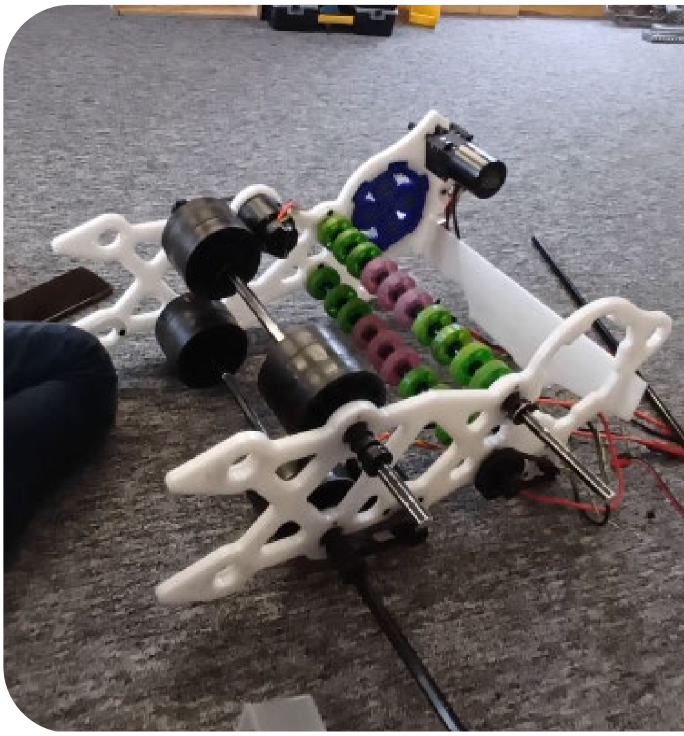
MDF: (Medium Density Fibreboard) is made with wood fibres. We use our CNC to manufacture it. MDF is easier than plywood to manufacture, but it is less robust. Consequently, it is use for prototypes because it is a practical material to manufacture even if it is not suitable for the final robot.



PLYWOOD: made up of thin layers of wood and is more resistant than MDF. Therefore, we use it for prototypes who need to be robust thanks to our CNC but the layers of wood of which it is composed can sometimes come apart. It is only suitable for the prototype and never appears on the final robot.

MATERIALS

PTFE:
(Polytetrafluoroethylene)
a synthetic material which has many interesting properties. It is a robust and light material (almost as robust as aluminium) and bends just before breaking. It can be very interesting, for sliding systems because it is a smooth material. We use it on the final robot and its great advantage (unlike aluminium) is that it can be manufactured with our CNC. This means that we can build some pieces of the final robot without any help of a partner.



PETG:(polyethylene terephthalatel) is a material we use for our 3D prints, We print spacers or special designs like the camera box and some mechanisms pieces like the antechamber to the shooter. We use it for its flexibility, its impacts resistance and for its ease of printing. Its cost is also very attractive.

MATERIALS

STEEL: It's the strongest material we can use on the final robot, but it's also the heaviest. We only use it for parts that need to be very solid (for example, certain parts of the drive train). We can't machine it, so we need help from our sponsors.

ALUMINIUM: lighter than steel, it reduces the overall weight of the robot and improves its manoeuvrability and speed. It also offers good mechanical solidity. It is the main material used on the robot. We use it for the bent plates and sheets. We need help from our sponsors to machine it. Aluminium is less rigid than steel and can have a certain flexibility, which is undesirable in some structures, but it is nonetheless an effective material for our robot.

R&D

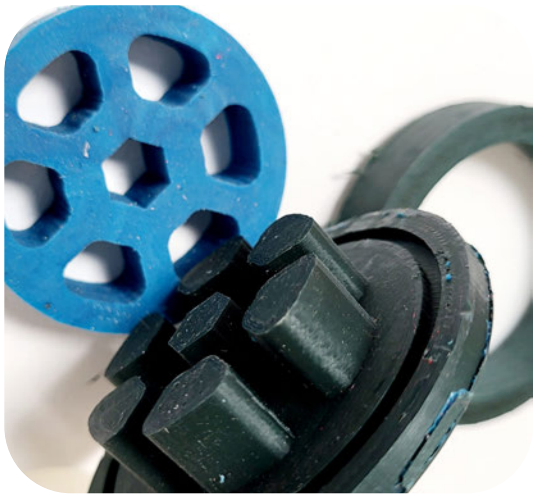
At Robo'Lyon, we innovate: instead of ordering parts like gears or wheels, we make them ourselves!
We are working to find solutions that will give us greater independence from parts suppliers, because getting parts from the USA is time-consuming and expensive.
That's why we've created a research and development department.

SILICONE WHEELS :

We made several tests with different commercial silicones. As a result, we chose Shore 50A silicone, which has the technical qualities required for the wheels in our mechanisms.

The steps involved in creating our wheels:

1. **create a 2-part mould in CAD**
2. **print in 3D**
3. **remove all bubbles from the silicone mixture by placing the assembly under a vacuum bell jar (to prevent any loss of density and risk of breakage and/or deformation of the wheels)**
4. **apply the silicone and let dry, then remove the wheels from the mould.**



DESIGN

R&D

NOTES :

Due to the limited stock of Notes, we decided to create our own for training and testing purposes. We 3D printed moulds and then poured polyurethane into them. We still haven't managed to find the perfect product, but the Notes tests have nevertheless been usefull to test prototypes such as the intake before we had the 'official' Notes.

GEARS :

This year, a partner printed gears for our transmission systems using 3D laser printing.

These new gears, made from polyamide 12, were manufactured by 3D printing using laser melting of plastic powder. This process enables us to produce complex-shaped parts with a high degree of precision.

The result is a gear that is 50% lighter, helping us to make our robot even lighter.

DESIGN

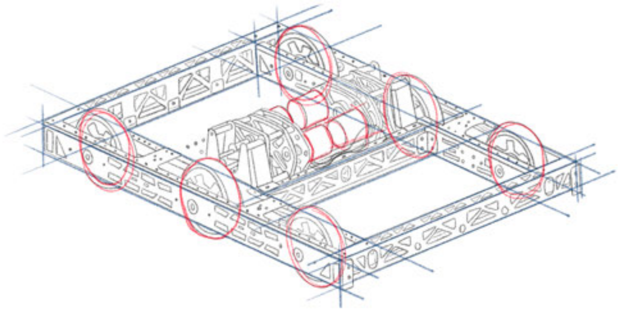
1. DRIVETRAIN
2. INTAKE
3. SHOOTER
4. CLIMBER
5. TENOR

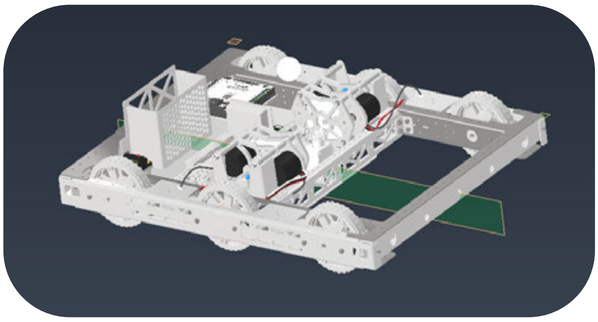
03. MECHANISMS

DRIVE TRAIN

GOAL

- Power & Robustness
- Fast Moves
- Quick Assembly & Disassembly





FEATURES

- 6 wheels
- 2 gearboxes
- 2 speeds :

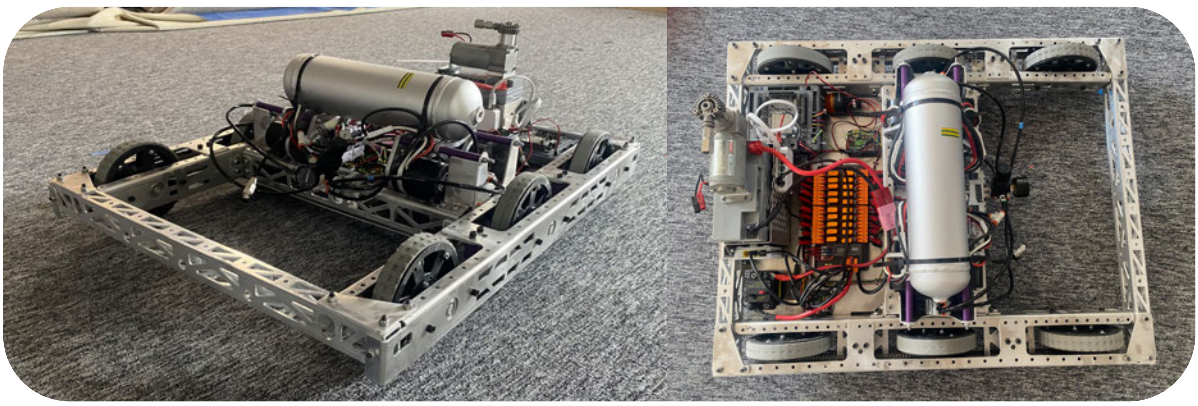
-12.1:1 i.e. 12.1 rpm input for 1 output
-7.6:1 i.e. 7.6 rpm input for 1 output

BENEFITS

- The balance between torque and the rotational speed of the motor allows the robot to have power and responsiveness to cross the field very quickly.

DISADVANTAGE:

- Less manoeuvrable than a swerve drivetrain.

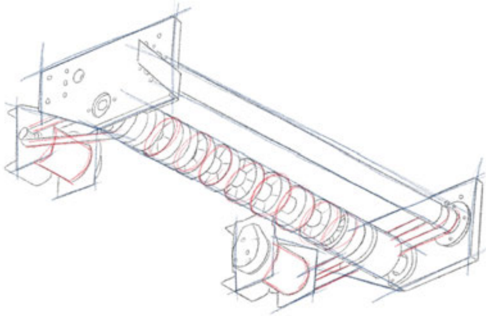


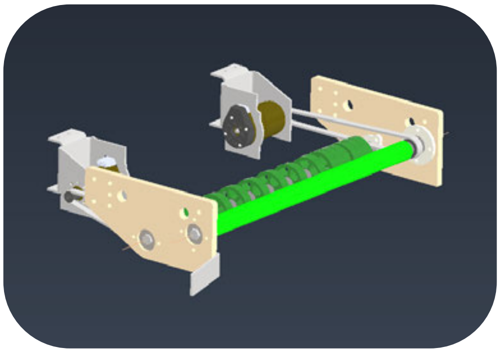
DESIGN

INTAKE

GOAL

- Pick up the notes on the floor, during AUTO period as well as during the rest of the match



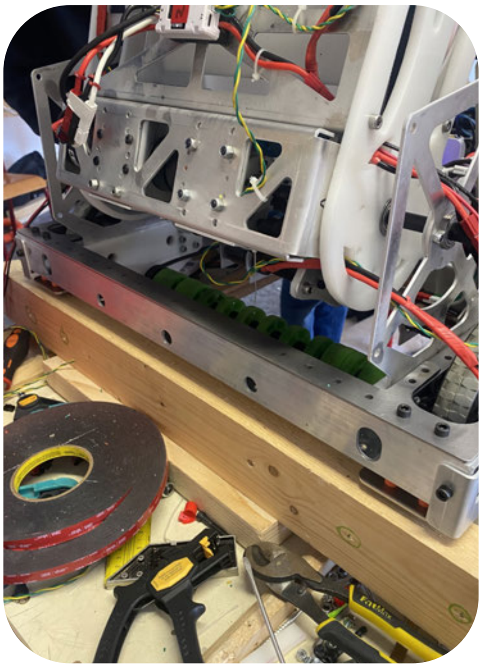


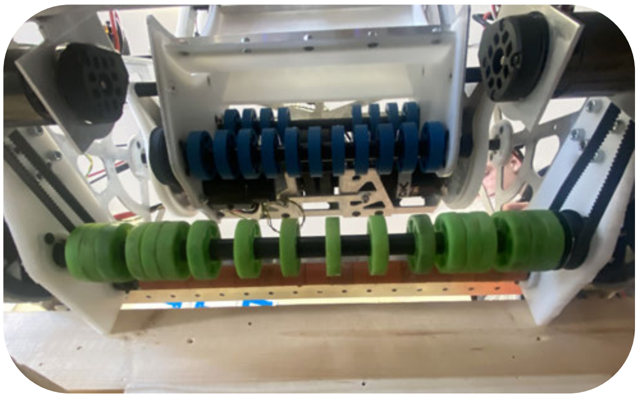
FEATURES

- 2 Axis 2in Horizontal Wheels
- 2 Motors 775PRO
- 2 Reduction for Wheel Row 2in
- 4 Reduction for Sushi Wheel Row

BENEFITS

- Connected directly to the shooter
- Quick to catch notes
- Space-saving on the robot
- Lightweight

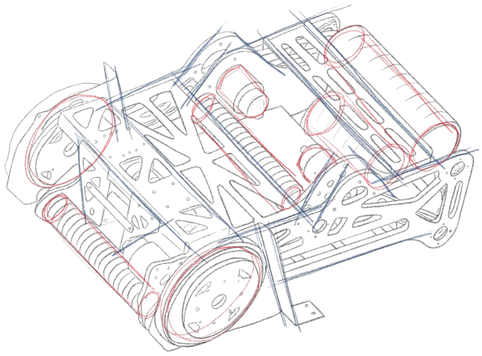




SHOOTER

GOAL

- Shoot in the AMP and the SPEAKER
- Facilitating the passage of NOTE



FEATURES

- Antechamber system with independent wheels
- Note compression by 15mm in pitch
- Pivot thanks to a herringbone house planetary with a reduction of 87.5

BENEFITS

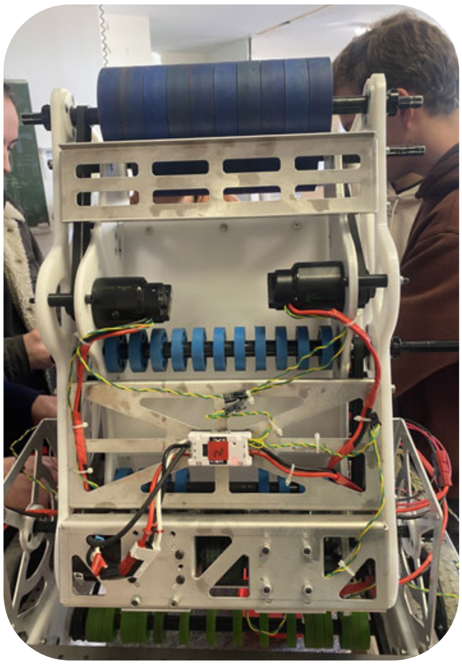
- Be able to retrieve the note inside the robot and at the source

- Be able to shoot into the AMP and SPEAKER

- Be able to shoot from the desired distance

DISADVANTAGE:

- Can not take and shoot at the same time

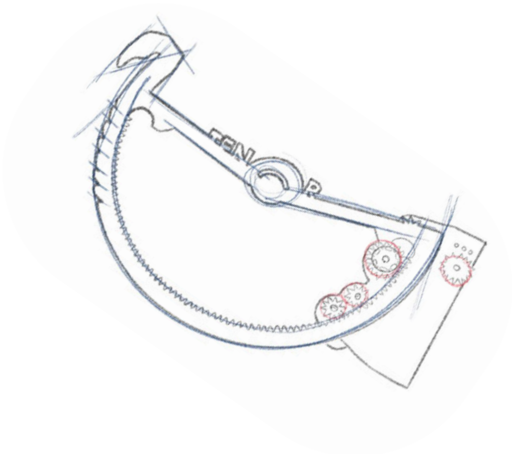


DESIGN

CLIMBER

GOAL

- Capable of lifting the robot on the chain
- Able to hold even when power is cut off
- Stability



FEATURES

- 47 reduction gearbox
- A housing to support the bow
- A 47 reduction bow
- 10mm hook

BENEFITS

- The arched rail allows the robot to be hooked to the chain on the robot's center of gravity and therefore gives it more stability on the chain

DISADVANTAGE:

- Can't shoot in the trap

DESIGN

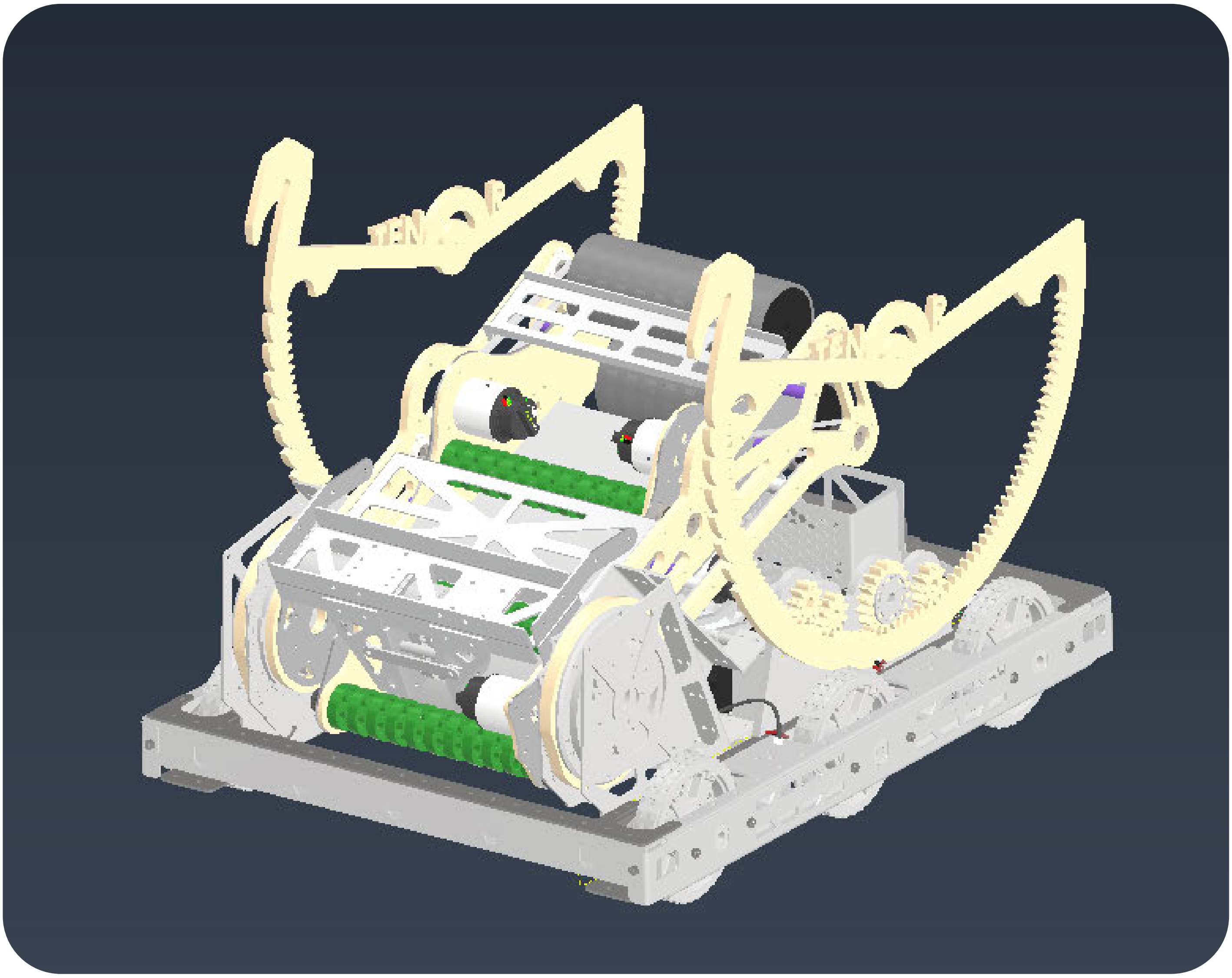
TENOR

Tenor drives fast

Tenor takes notes

Tenor shoots notes

Tenor climbs
on the stage chain



ROBO'LYON
The FIRST French Team

1. ELECTRONICS
2. VISUAL PROCESSING
3. AUTO PERIOD

04. ELEC. & PROG.

ELECTRONICS

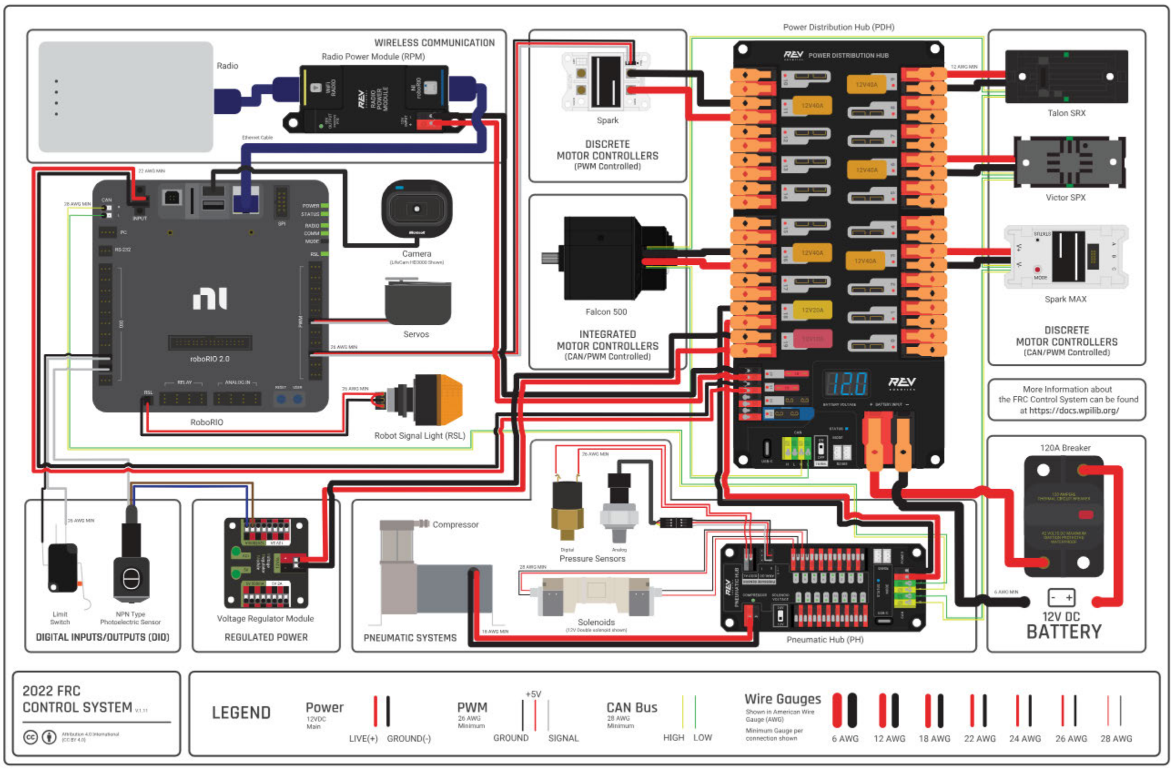
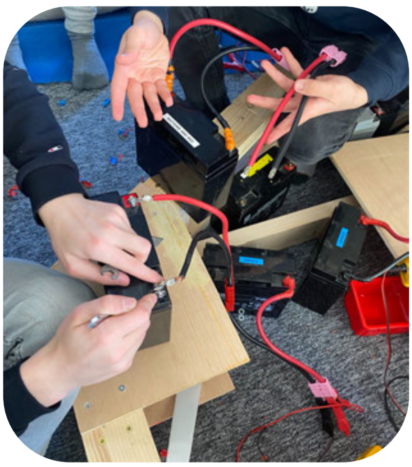


Diagramme de l'équipe FRC® 3161 et Stefen Acepcion sur WPIlib FRC

MAIN COMPONENTS OF THE ELECTRIC HUB:

Battery :
-Main source of electrical power.

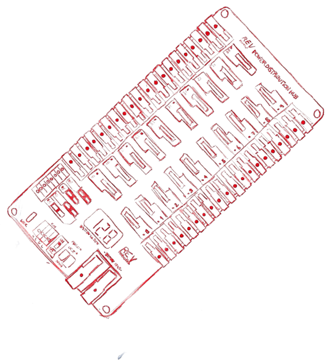


Main Breaker (with busbar) :
-Main safety switch.
-Incorporates a busbar for electrical distribution.

ELEC. & PROG.

ELECTRONICS

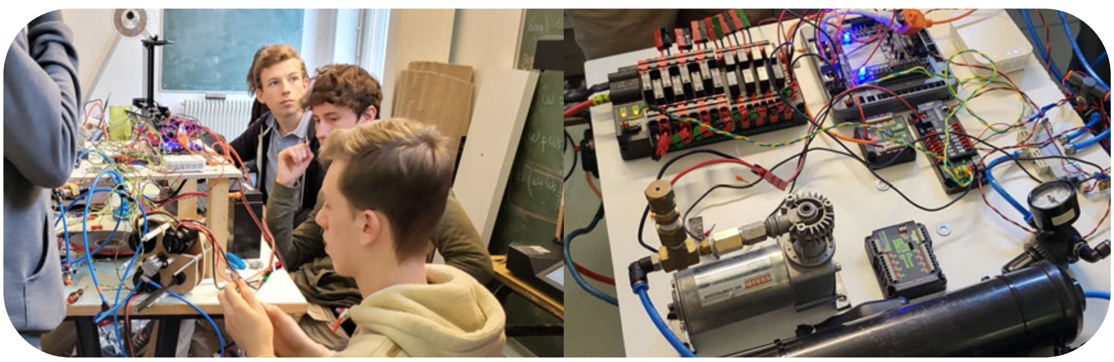
Power Distribution Hub (PDH) :
-Connected in series to the battery and the Main Breaker.
-Recovers energy from the battery.
-12-volt fuses regulate voltage and electrical flow.



RoboRIO :
-Connected to the PDH.
-Main system controller.

Radio Power Module :
-Connected to the PDH to receive a 12V power supply.

Ethernet connections :
-An Ethernet input is connected to the RoboRIO Ethernet port.
-An Ethernet output is connected to a Wi-Fi terminal via Ethernet.
-The Wi-Fi terminal is connected to the PC via a Wi-Fi connection.

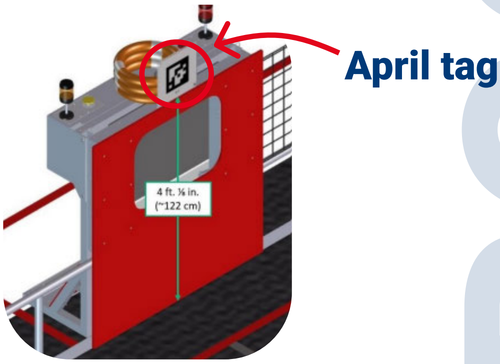


VISUAL PROCESSING:

EXCLUSIVELY IN TELEOP PERIOD

Preparing the PhotonVision software :
-Importing the photonvision library into WPILib.
-Using Visual Studio Code as a code editor, compiler and executor.

Calibration and orientation of the robot:
-Use of April Tags for calibration and precise orientation of the robot for aiming.



2024 FRC GAME MANUAL

Robot control and monitoring:
-Using the FRC Driver Station to monitor the status of the robot.
-Checking communication is correct and that the code has been integrated into the RoboRIO.

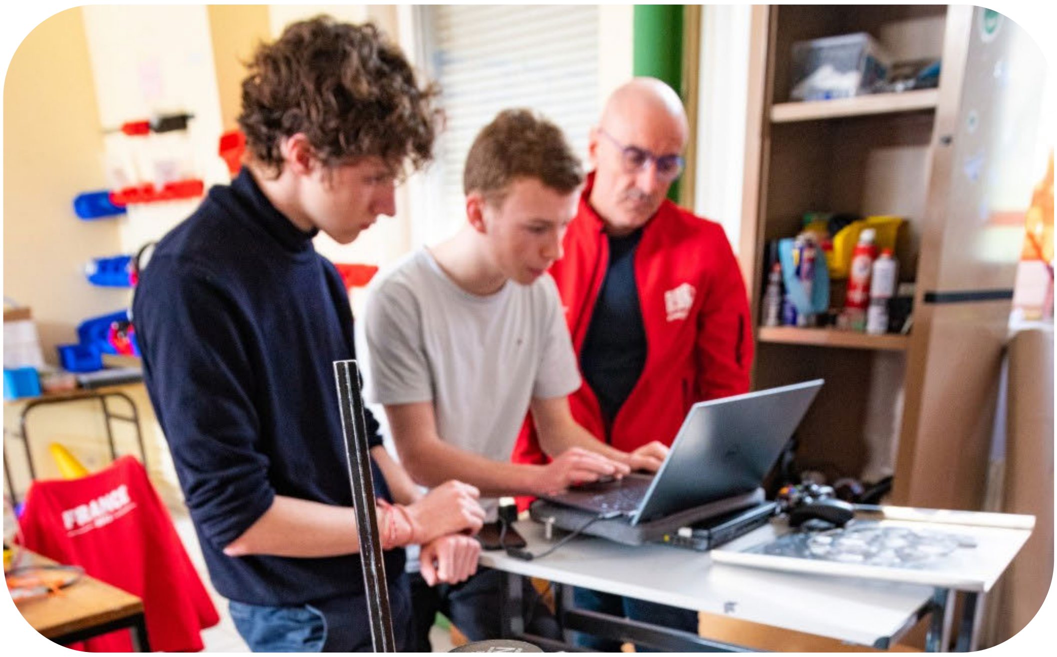
Advantages of the configuration :
-Possibility of semi-automatic or even automatic aiming with easy calibration thanks to April Tags.

Hardware configuration :
-Connection cameras, including infrared infrared cameras to the Raspberry Pi.
-Use of the Raspberry Pi as a dedicated processor to acquire information from the April Tags.

Data transmission:
-Transmission of data from the cameras to the RoboRIO via a a Wi-Fi terminal.
-Use of the control computer equipped with PhotonVision and a T.16000M FCS joystick for precise handling.

ELEC. & PROG.

AUTO PERIOD



Autonomous period :
-Import of field data and determination of optimised trajectories. Conversion of trajectories into code that can be used by the robot using in-house software.

Adaptability of the in-house software:
-Although requiring additional work for its development, the software adapts perfectly to the specific needs of the robot.

Control and program organization:
-Use of encoders at the gearbox output to measure the robot's speed.
-The RoboRIO controls the speed using information from the encoder via the controller.
-The computer is used for basic start and stop operations, providing a basis for control.

Objective of the autonomous period :
-To recover as many objects as possible within 15 seconds.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