Robot Club Toulon : Mechanical Presentation 2025

M. Walter, M.Bièche, V. Gies, and al.

Université de Toulon,
Avenue de l'Université, 83130 La Garde, France
rct@univ-tln.fr
Home page : https://robotclubtoulon.com/

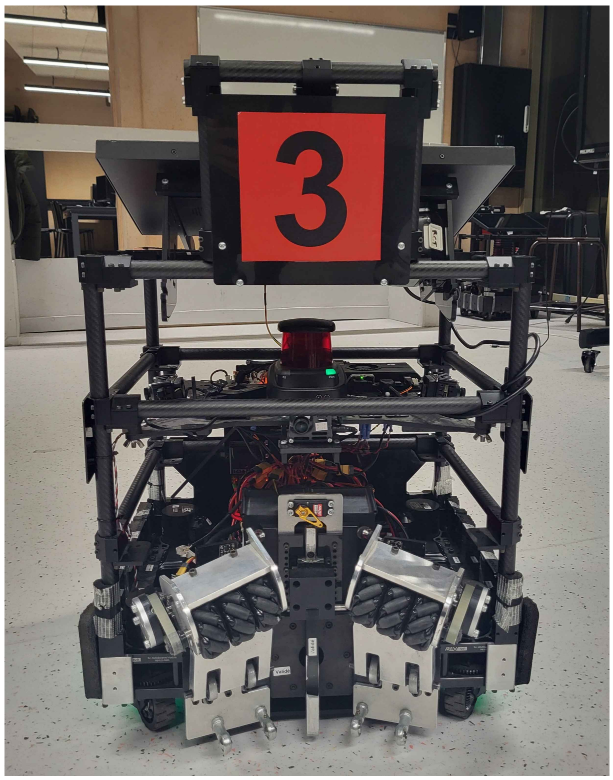

Fig. 1. 2025 robot of Robot Club Toulon Team

Robot Club Toulon is a team who participate since 2019 ant the Middle Size League of the RoboCup. Every year robots are evolving toward the goal of 2050.

All the mechanical architecture is presented bellow.

1 Propulsion

In 2024 the decision has been taken to build a swerve drive propulsion system.

Better performance and more polyvalence are the main reasons why the design has been changed.

Our robots were limited to 3 $m.s^{-1}$, with an acceleration of 1.2 $m.s^{-2}$. With the new swerve drive propulsion, maximum speed can reach 7 $m.s^{-1}$ with an acceleration of 3 $m.s^{-2}$. These huge differences allow a lot of new strategy options for the future.

The new base has been designed using 4 swerve drives, integrated in a rectangular shaped design. Each propulsion motor of the swerve drive is a 500W brushless one. In order to improve reliability of the robots, most of the parts will be manufactured in aluminium, and the upper part of the robot will be mainly in carbon fiber to lower the gravity center of the robot. These robots have been successfully tested during RoboCup 2024, even if they were ready only 5 days before the competition. One drawback have been observed on motor control, due to the poor performances of the built-in encoders of the brushless motor (NEO V1.0) used (50 pts/revolution) Since this competition, motors have been replaced by a new version (NEO VORTEX) having more than 7000 pts/revolution. This allows a far better control

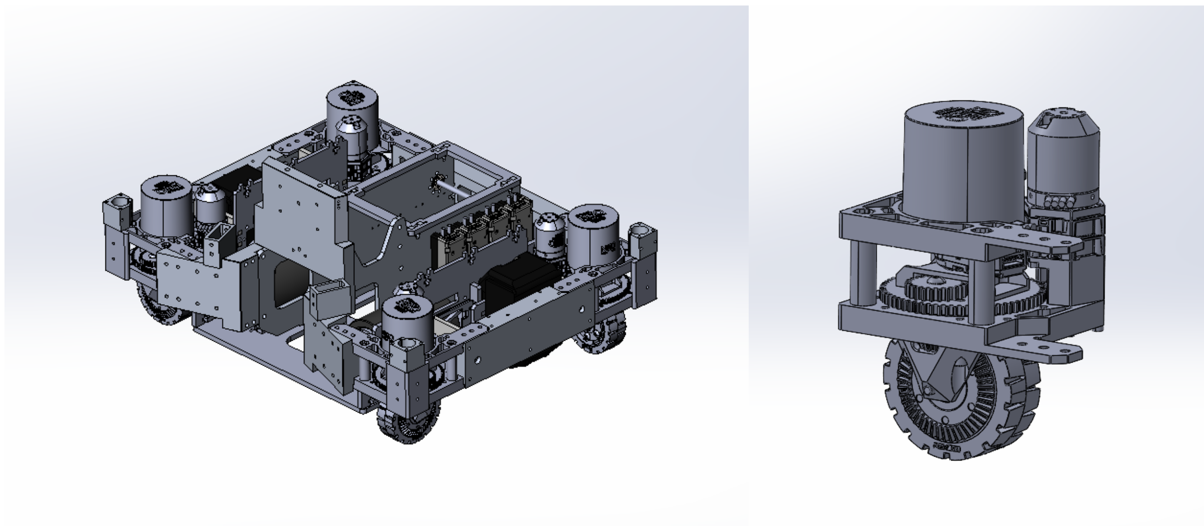

Fig. 2. propulsion system

2 Chassis

To optimize weight reduction, numerous components were replaced with carbon fiber tubes, while the remaining parts were meticulously designed and fabricated from aluminum. The robot's chassis is built upon a set of reference pieces that are replicated and utilized throughout the entire structure. This modular approach facilitates quicker maintenance and repairs, while also enhancing accessibility to critical components.

Furthermore, the placement of aluminum at the base and the carbon fiber in the upper sections effectively lowers the robot's center of gravity. This configuration not only reduces overall weight but also improves stability and performance. The use of lightweight materials like carbon fiber, particularly in the upper structure, significantly decreases the robot's mass without compromising strength. Meanwhile, the aluminum components in the lower sections provide a solid foundation while enhancing the robot's balance and maneuverability.

This design results in a robot that is not only lighter and more agile but also easier to maintain and repair, showcasing an optimal balance between performance, durability, and serviceability.

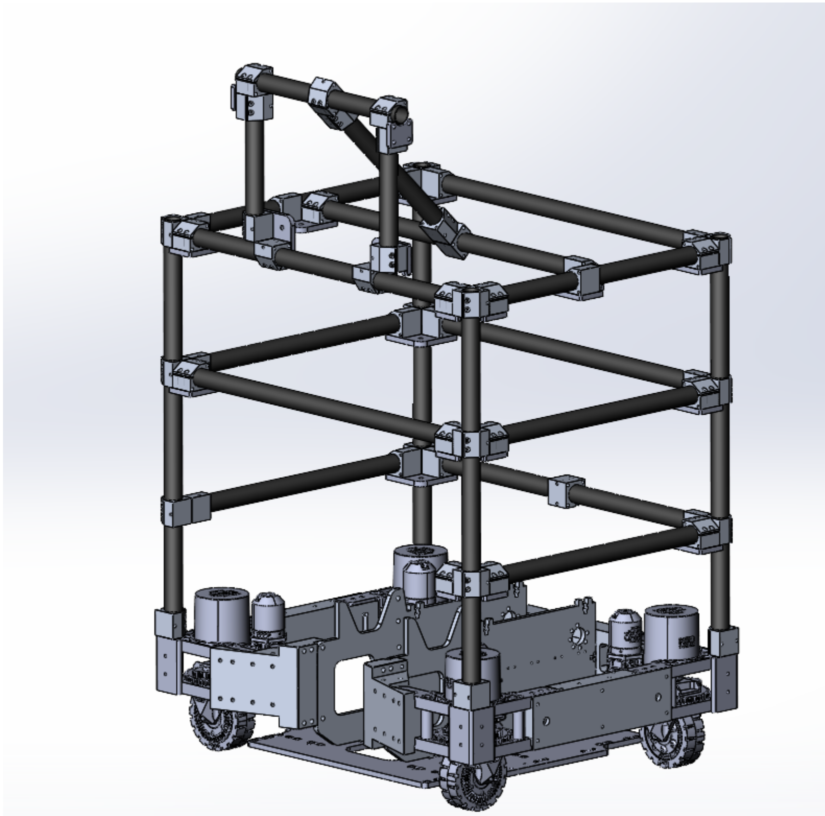

Fig. 3. carbon and aluminum chassis

3 Ball hanling

The robots have undergone a significant upgrade in ball handling capabilities, marking a substantial leap forward in performance and precision. The core improvements include the retention of the proven omniwheel technology atop the ball with optimized wheel angles for superior control and maneuverability.

The angles were optimized through an extensive series of empirical tests, involving a substantial number of trials and evaluations. This experimental approach allowed the fine-tuning of the system for optimal performance, ensuring that the final configuration was based on real-world data and practical outcomes rather than theoretical models alone which were harder to obtain.

This design allows for a seamless catch mechanism, and fits the speed and agility obtained with the swerve drives, providing precise movements that allows for complex maneuvers and rapid directional changes. This advancement results in a more responsive, adaptable, and efficient ball handling system.

Overall, these small improvements have elevated the team robots' ability to manage and transport the ball with increased control and reliability.

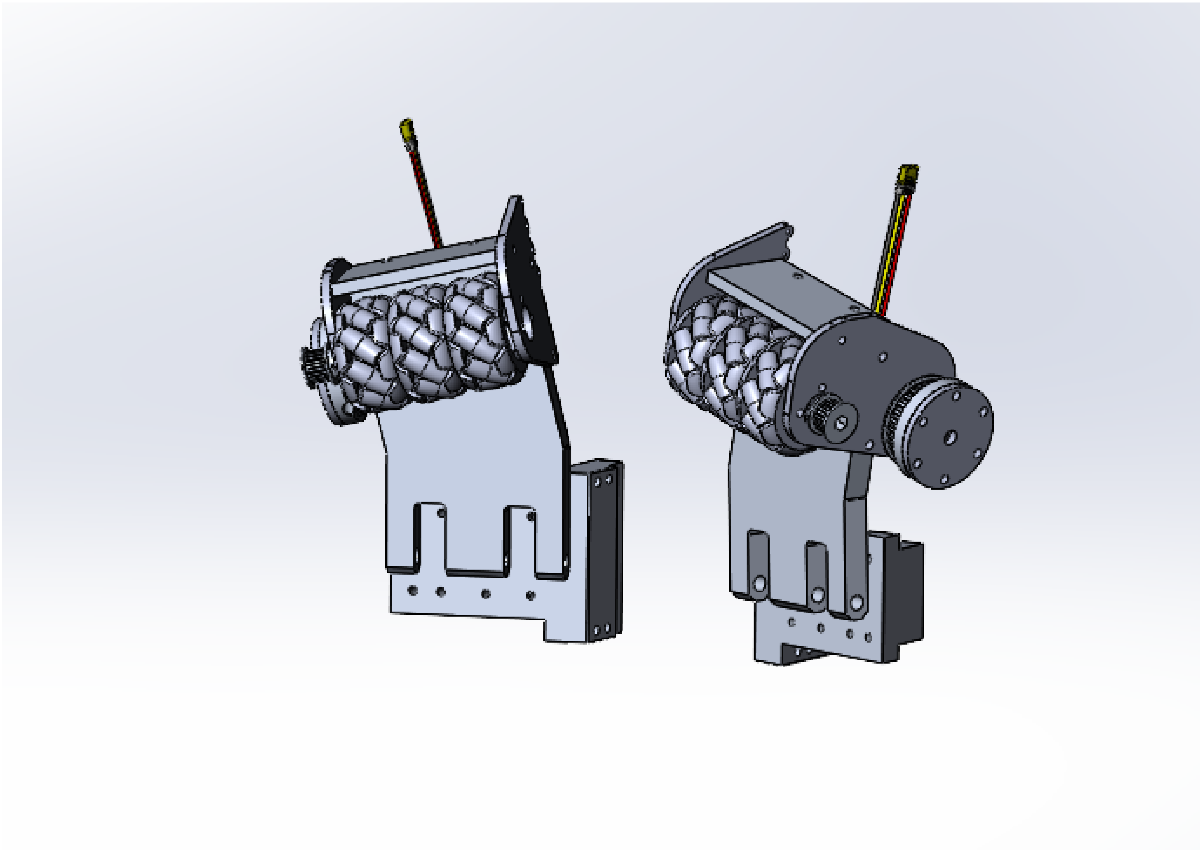

Fig. 4. Ball handling system

This ballhandling system was used in real conditions at 2024 RoboCup in Eindhoven and proved its efficiency.

4 Goalkeeper

The goalkeeper design has evolved significantly since its introduction at RoboCup in Bordeaux two years ago. Initially featuring two arms, the system faced reliability issues and numerous drawbacks. For the 2024 competition, the team has implemented a major redesign, replacing the dual-arm mechanism with a single, more efficient arm equipped with an extension.

This new goalkeeper arm aims to achieve rapid ball interception, with a target response time of 0.5 seconds or less. To meet this ambitious goal, the system incorporates powerful actuators capable of deploying in 0.2-0.3 seconds and an extension mechanism for increased reach **??**.

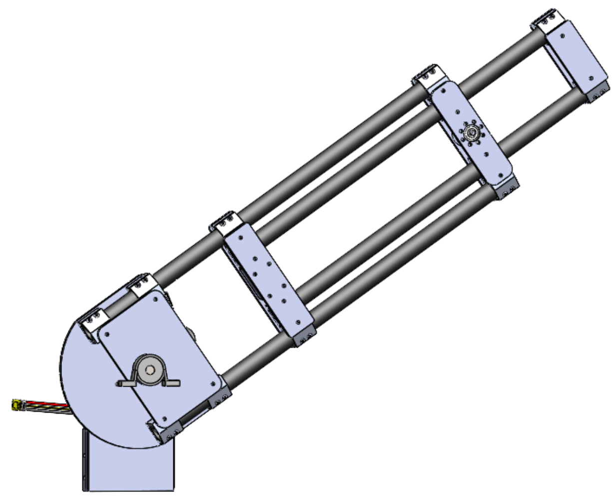

Fig. 5. RCT keeper arm

The arm is constructed using carbon fiber materials, resulting in a remarkably lightweight structure. This choice of material is crucial for achieving rapid acceleration and deceleration of the arm, minimizing inertia during movement, and increasing the overall system responsiveness.

A pulley system is integrated into the design to facilitate arm extension. This mechanism allows the goalkeeper to increase reach without compromising speed and gives efficient power transfer from the actuators to the arm.

Moreover, two gears are employed to rotate the arm. This gear system provides precise control over the arm's angular position and a high torque for rapid directional changes, improving accuracy in intercepting shots.

The combination of these elements results in a highly efficient and responsive goalkeeper arm. This design allows the goalkeeper to react swiftly to incoming shots, covering a wide area of the goal with minimal response time.

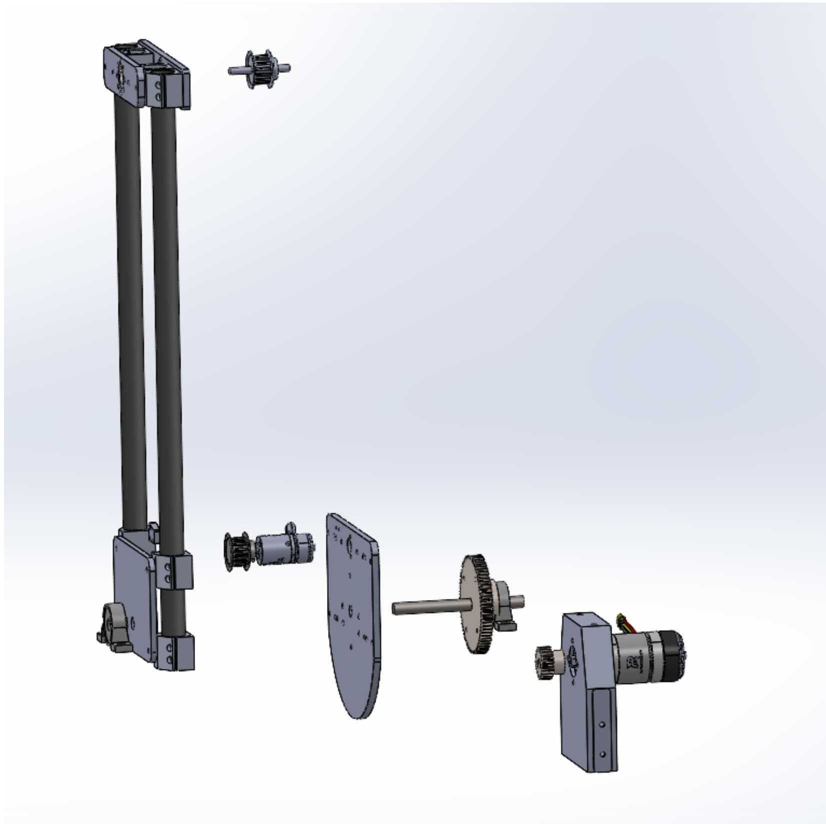

Fig. 6. RCT keeper arm exploded view

While this new single-arm goalkeeper is nearing completion, with the arm's structure and mechanisms fully developed, it represents a significant improvement over the previous iteration.

5 Kicking system

fOR kicking system two coils are used and allow a 75 Km/h speed for the ball. A precision of 2cm at 25m is allowed.

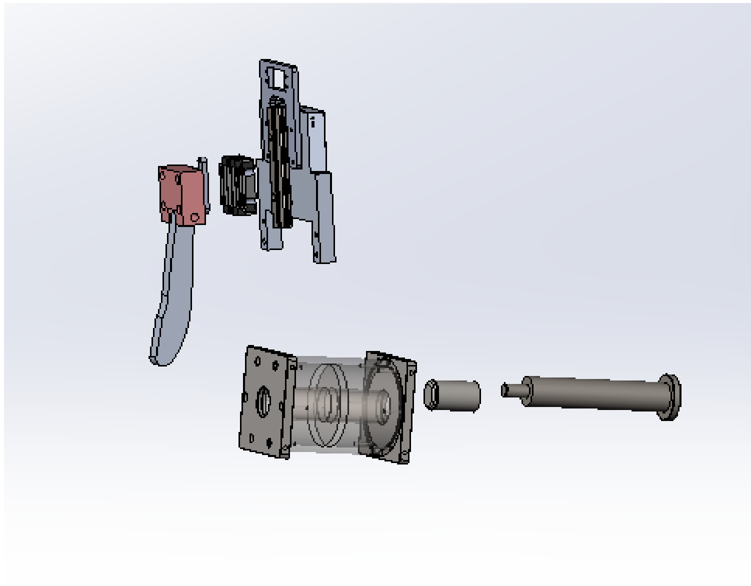

Fig. 7. Exploded view of kicking system