2025-2026 SEASON

ROBOTS

Innovation Design Creativity Impact Problem-solving STEM Build

RO_009

#19082 DECODE

ROBOAS #19082

CONTENT:

ROBOAS #19082

CONTENT:

ROBOAS #19082

CONTENT:

1. ABOUT US

Innovation Design Creativity Impact Problem-solving STEM Build

ABOUT ROBOAS

RoboAS is the robotics team of the "Andrei Şaguna" National College in Brașov, active in the FIRST Tech Challenge Romania competition. Made up of students passionate about engineering, programming and innovation, the team annually develops autonomous and remote-controlled robots, integrating advanced technical skills with game strategy, project management and marketing and PR activities. Over the seasons, RoboAS has achieved important results both nationally and internationally, becoming a team recognized for innovation, creativity and team spirit. We have been active in FTC for 10 years, joining the competition when it was first introduced to Romania by Natie Prin Educatie. While RoboAS has maintained a consistent presence with multiple awards over the years, our technical performance has seen significant growth.

ACHIEVEMENTS

- Innovate I, National and Regional Championships (2025-2026)
- Innovate I, National Championship, Regional Championship, European Premier Event (2024-2025)
- Natie Prin Educatie Award (2023-2024)
- Judges' Choice Award (2021-2022)
- Collins Aerospace Innovate Award (2020-2021)
- Rockwell Collins Innovation and Design Award (2016-2017)

ROBOAS #19082

MEET THE ENGINEERING

Rares
-lead engineer

Alex
-human player

Radu
-coach

Maria

Dacian

Oliver

Paisia

Ami

Vlad
- alumni

ROBOAS #19082

MEET THE

PROGRAMMING

Tea
-lead programmer/ driver

Victor

Alex

Daria
- alumni

MARKETING & PR

Rianna

Otilia

Anastasia

Lizica

ROBOAS #19082

MEET THE MENTORS

Bogdan Fodor

Codruța Miron

Claudia Puia

Radu Meșa

Anna Maria Nedelea

Carmina Vakulovski

THIS IS OUR TEAM!

ROBOAS #19082

ABOUT OUR DEPARTAMENTS

The RoboAS team consists of three departments: Engineering, Programming, and Marketing & PR. These departments work together to develop and promote the team's robotics projects. Each department plays an essential role in our success.

ENGINEERING DEPARTMENT

The Engineering Department is responsible for designing, building and innovating the mechanical and electronic components of the robot, choosing the right materials and integrating the various systems necessary for its operation.

ROBOT CONCEPTUALIZATION

- **CAD design**
- **Testing and optimization**
- **Component design**
- **Mounting of electronic components**
- **Chassis construction**
- **Assembly of mechanisms**

ROBOAS #19082

PROGRAMMING DEPARTMENT

The Programming Department is responsible for developing and optimizing the robot's software. It ensures the efficient operation of the robot in autonomous and teleoperated modes, by integrating the sensors, algorithms and control systems necessary for competition performance. Through continuous testing and code improvement, the team directly contributes to the robot's performance and reliability.

Concept & System Design

- deciding on Autonomous and TeleOp structure
- defining core ideas and software architecture

Motion & Path Planning

- movement math (e.g., turret control, drivetrain)
- custom path optimization

Subsystem Logic

- organizing robot mechanisms (intake, shooter, turret, etc.)
- defining logic for each subsystem

Autonomous Development

- building autonomous routines
- integrating sensors and decision-making systems

TeleOp Development

- driver control implementation
- button mapping and intuitive control design

System Integration (Auto + TeleOp)

- connecting all subsystems
- ensuring smooth transitions between modes

ROBOAS #19082

MARKETING & PR DEPARTMENT

The Marketing & PR department is responsible for promoting the team and its robotics projects. The members of this department are in charge of creating content for social media, managing the team's image, and communicating with the public, sponsors, and partners. They also maintain communication with other robotics teams, building connections and fostering friendly relationships within the community.

They promote the team's activities and achievements, helping to increase visibility and attract support. Through creativity and communication skills, this department helps the team build a strong and professional image in the community.

Roles in department

- Graphic Design for Posts
- Taking & Editing Photos
- Posting on Social Networks
- Financial Manager
- Team Documentation
- Graphic design for promotional materials

Social Media

- INSTAGRAM
- FACEBOOK
- LINKEDIN
- TIKTOK
- YOUTUBE
- WEB

roboas_19082

roboas_009

roboas19082

roboas.netlify.app

RoboAS FIRST Tech Challenge Team

roboas19082

2025-2026 SEASON

2. ORGANISATION

Innovation Design Creativity Impact Problem-solving STEM Build

RO_009

#19082 DECODE

ROBOAS #19082

RECRUITING PROCESS

APPLICATION PROCESS

The recruitment process began with the completion of an application form, followed by an online interview with team leads and mentors. The interview was designed to evaluate motivation, teamwork abilities, and working style, with a focus on how candidates respond to specific situations. The process concluded with a face-to-face meeting aimed at introducing the team structure, responsibilities, and expectations.

MEMBER RECRUITMENT

SUMMER RECRUITMENT :

The July recruitment round was open to all students within the school, including both middle school and high school students. This period was chosen due to the increased availability for training during the summer. The process included practical tasks and continuous mentoring, allowing for a smoother and faster integration of new members.

AUTUMN RECRUITMENT :

The October recruitment was targeted specifically at 9th-grade students. Team presentations were held throughout the school to increase awareness of the robotics team. Additionally, a robotics display was placed in the main hall to improve visibility and attract interest among students.

40+ members

THE INTEGRATION PROCESS

- Introductory training sessions (team structure, tools, workflows)
- Starting with simple, practical tasks
- Gradual increase in responsibility and task complexity
- Continuous feedback and hands-on learning
- Collaboration with experienced members
- Regular progress tracking and support

ROBOAS #19082

PLATFORMS FOR WORKING

This year we have managed to maximize time efficiency by carrying out programming and engineering activities simultaneously. To achieve this, we use two identical work platforms, each with a clear role in the development of the robot. One of the platforms is used by the programming department, while the other is intended for the mechanical engineering team. This division allows us to progress simultaneously, without one department depending on the completion of the other. At the beginning of the season, when the programmers are working on generating trajectories and developing the code, those in the engineering department can immediately begin the physical construction of the mechanisms. Once engineering completes and validates the operation of a mechanism, it is replicated identically and mounted on the programming platform. This way, the software can be tested directly on a fully functional assembly, without delays.

MARKETING & PR	ENGINEERING	PROGRAMMING
→ CANVA	→ FUSION 360	→ JAVA
→ FIGMA	→ GOBILDA	
→ TEAMGANTT		

ROBOAS #19082

UPGRADING OUR WORK SPACE

At the beginning of the school year we moved our work area to a more spacious space, which allowed the team to assemble their robot field. The laboratory offers optimal conditions for testing robots, organizing components and conducting team activities. This change represented an important step in the evolution of the team, being designed to support its needs: storage space, space for teamwork, assembly and testing area.

This spring, the mentors began setting up a new off-campus workspace to allow for greater flexibility and independence from school schedules. This new space allows us to run longer, more efficient work sessions, have constant access to the necessary equipment, and better prepare for off-season competitions.

The space is also large enough to invite other robotics teams from other cities for practice sessions. This gives us the opportunity to test our robots in competition-like conditions, share experiences, and strengthen relationships with other teams in the FTC community.

2025-2026 SEASON

3. EVENTS

Innovation Design Creativity Impact Problem-solving STEM Build

RO_009

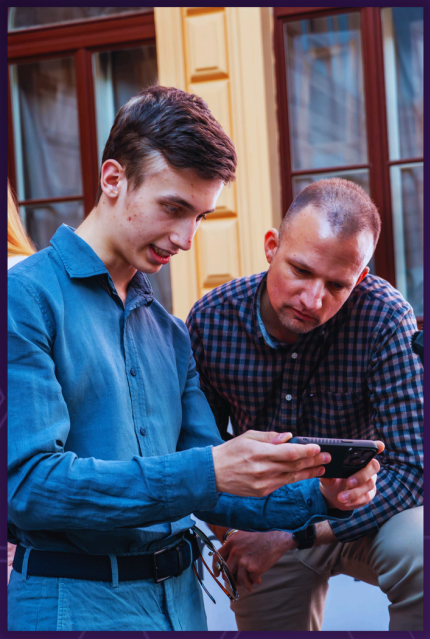
#19082 DECODE

ROBOAS #19082

FWDBV TALKS

FWDBV Talks is the event through which the fwdBV business magazine, Forward Brașov, brings together twice a year the leaders of the local economic community in a framework dedicated to dialogue and innovation, organized in partnership with Transilvania University of Brașov.

The June 2025 edition brought a fresh perspective thanks to the participation of members of the robotics team of the Andrei Șaguna National College, RoboAS. The meeting offered the opportunity to show the Brașov community how alternative education takes shape.



in FIRST Tech Challenge competitions and how high school students develop advanced technical projects, along with a variety of essential skills for the future.

The discussions highlighted the impact of these programs on the training of young people, highlighting discipline, creativity and collaboration. For the business environment in Brașov, the event was an opportunity to connect with the generation that shapes the future, a generation prepared with solid skills and a mature technological vision.

22.06.2025

ROBOAS #19082

VISITING SIEMENS COMPANY

We visited the headquarters of Siemens, one of our main sponsors and a constant supporter of our projects in past seasons. The meeting aimed to strengthen the collaboration and reaffirm the common commitment to the development of STEM education and technological innovation.

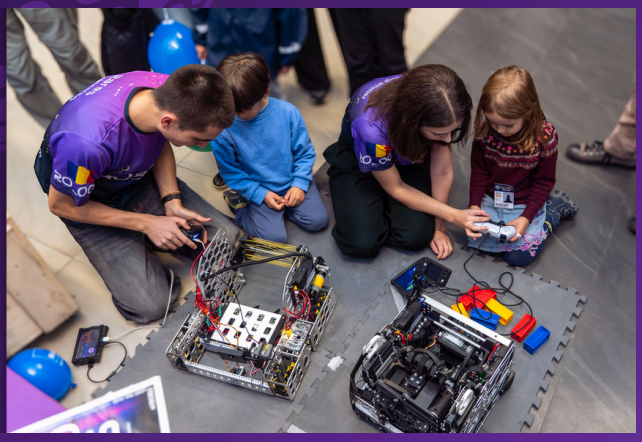
During the visit, we presented the evolution of the team, ongoing projects and plans for the current competitive season. Siemens representatives reconfirmed their active support and offered us suggestions on the applicability of robotics in industry and society, emphasizing how the skills developed within the team — from programming and engineering, to collaboration and critical thinking — can be put into practice in areas such as automation and smart manufacturing

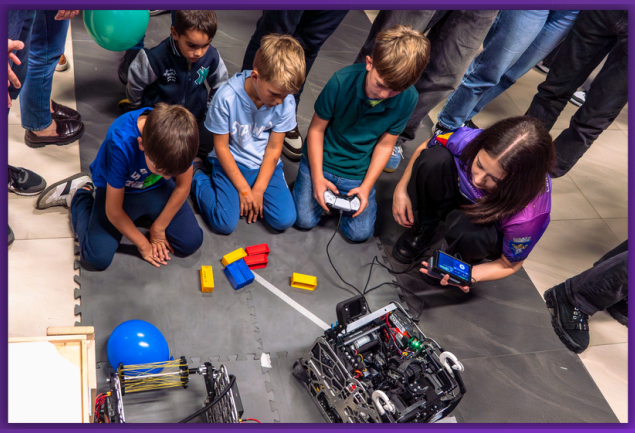
09.09.2025

ROBOAS #19082

RESEARCHERS' NIGHT

The team's participation in the Brașov Researchers' Night was possible thanks to the invitation received from the Brașov Community Foundation, our sponsor. The event organized by Transilvania University Brașov aims to bring research closer to the public and to highlight the essential role of science in our lives. With over 1000 participants, the event contributed to creating direct communication between the team and the community.





The children had the opportunity to interact with the robot, discovering its precise movements and complex functionality. The little visitors had the opportunity to learn about the mechanisms behind the technology: omni-directional wheels, articulated arms, sensors and control algorithms. The team members passionately explained the mechanical concepts and subsystems used in the FTC competitions, explaining the technical notions in a way that everyone can understand. Through the open dialogue with the public, especially with young people, the team managed to arouse curiosity for the world of robotics and encourage STEM vocations. Many children left with answers to questions, ideas, and a desire to explore this field further. With every explanation offered, with every smile elicited by the robot, the team instilled confidence that science is a language for everyone, capable of shaping a future full of possibilities.

26.09.2025

ROBOAS #19082

VISITING ROUND TABLE

On October 2, we had the joy of marking and celebrating the success of the "Paper Airplanes" event, organized together with Round Table Brașov. The meeting represented a moment of appreciation for all those involved in the project and an opportunity to recall the experiences and results obtained during the organization of the event.

The atmosphere was relaxed and friendly, giving us the opportunity to spend time with our partners who supported us and to strengthen the relationships built during our collaboration. It was also a good opportunity to discuss the impact of the event and future initiatives we could carry out together.

02.10.2025

ROBOAS #19082

PRESENTING THE FTC PROGRAM

On October 6th and 7th, we had the opportunity to interact with middle and high school students, introducing them to the FTC program and the work carried out within the team. During the meetings, we told them about our passion for robotics, the process of building and programming a robot, as well as the experiences we had in the competitions we participate in.

We also promoted the importance of STEM fields, explaining how these areas underpin robotics and how they can be applied in real-world projects. Through practical examples and interactive discussions, we showed students how the knowledge they acquired at school can be used to build innovative and functional solutions.

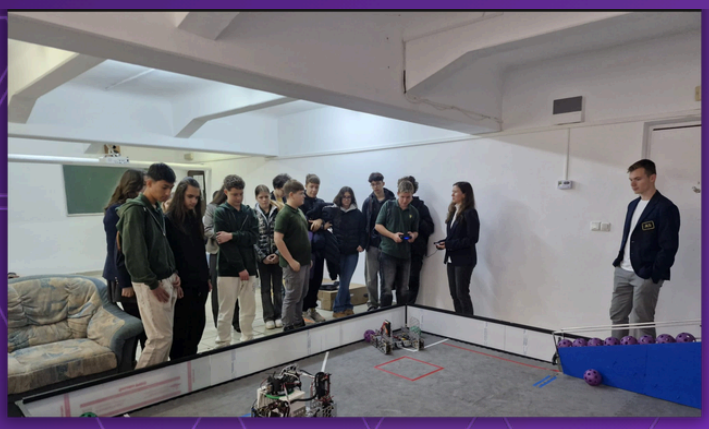
We were delighted to see the students' interest and curiosity, as well as the many questions they had about robotics and the competitions. We hope that this activity has succeeded in inspiring a new generation of future engineers, programmers and innovators and giving them the confidence to explore the field of technology.

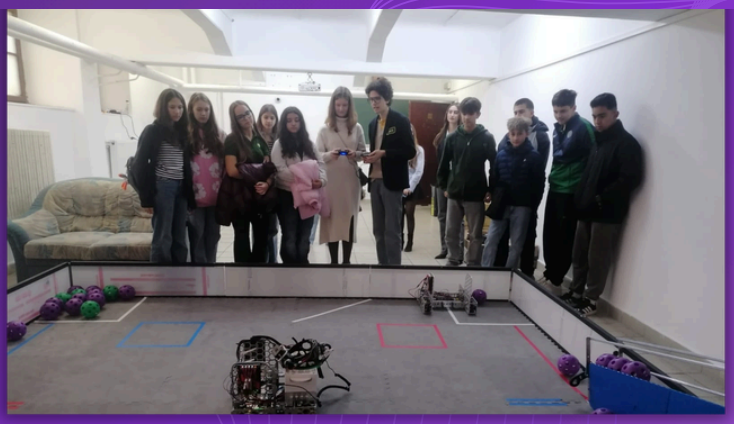
06.10.2025-07.10.2025

ROBOAS #19082

ACTIVITY DEDICATED TO 8TH GRADE STUDENTS

Eighth grade students from a school in Sânpetru were invited to our school for a visit. The meeting had an educational character: students are at a decisive moment: choosing a high school, and our goal was to give them a clear picture of the benefits of a performance education, to help them make an informed and motivating decision. We presented the laboratory to them and told them about the FTC competitions, what it means to be part of a robotics team and what the competitive experience of participating in national and international competitions was like.





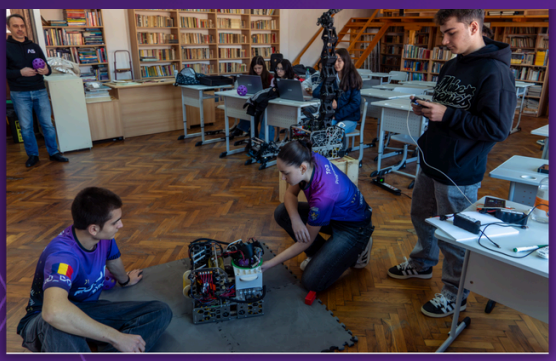
The students were excited and involved throughout the visit and a few of the brave ones tested piloting the robot directly. The visit led some students to carefully consider STEM-oriented high schools, seeing the opportunities offered by programs like FTC

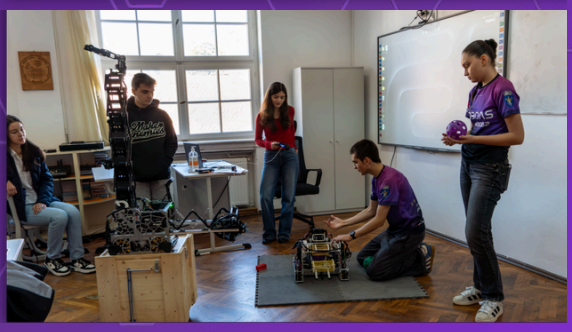
10.10.2025

ROBOAS #19082

WORKSHOP ABOUT PROGRAMMING AND ENGINEERING

As part of the "Alternative School" program, we organized a workshop dedicated to 9th grade students, with the objective of familiarizing them with elements of programming and applied engineering. The activity was designed to provide a complete educational experience, combining introductory presentations with practical exercises, so that each participant could understand and directly experience the processes behind the construction and control of a robot.





To ensure an efficient development and the best possible interaction, the students were divided into two groups.

• The first group started with the programming session, where the students discovered the basic principles of the code, the logic of the algorithms and how the commands are transformed into robot actions.

• The second group initially participated in the engineering workshop, where they explored the mechanical components, the structure of a robot and how each element contributes to the functioning of the assembly.

After the first part, the groups swapped, so that all students could benefit from both experiences.

22.10.2025

ROBOAS #19082

OUTREACH ACTIVITY AT THE CHILDREN'S HOSPITAL

During the “School Otherwise” Week, we went to the Children’s Hospital in Brașov, where some of the strongest and bravest children we have ever met were waiting for us. The initiative aimed to bring science closer to the little ones and transform an ordinary hospital day into one full of curiosity, smiles and inspiration. The demonstration was adapted so that every child could safely interact with technology.

The hospitalized children were enthusiastic and delighted to discover the world of robotics. For many of them, it was the first direct encounter with the world of robotics, and for us, it was a confirmation that technological education can bring joy even in delicate contexts. Beyond the educational aspect, the visit had a strong emotional charge. Interacting with them was a lesson in courage and resilience, and their willingness to learn and explore, despite difficulties, gave our team a deeply human perspective on the role that technology can play in people's lives.

23.10.2025

ROBOAS #19082

DEMO METAL

At Demo Metal Brașov 2025, a technology and innovation fair held between November 11–13, we were present with our own stand, which allowed us to present both the robot and the results of the last competition season to visitors. We also had the chance to talk to other companies that had stands at the event. We managed to get acquainted with industrial robots and were inspired by the experiences of companies with many years of activity in the field of automation. They motivated us to imagine what our own projects in the industry could look like.

The team demonstrated how the robot works and actively promoted the FTC educational program, explaining the structure of the competition, the benefits for students and the impact on technical and personal development.

11.11.2025-13.11.2025

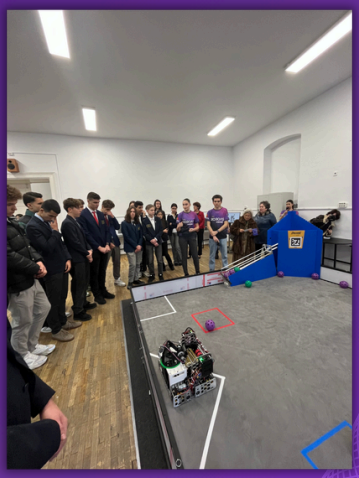
ROBOAS #19082

SAGUNA FEST

On the occasion of “Şaguna Fest”, an event dedicated to the celebration of 175 years since the founding of the “Andrei Şaguna” National College, we were present with an interactive stand as part of the activities organized at the high school level.

During the event, we welcomed the visiting classes and presented the team’s work, giving them an overview of the FTC program and how a competition robot works. We also conducted live demonstrations with the robot, highlighting the mechanisms, control systems and how it is used in matches.






During the event, we welcomed the visiting classes and presented the team’s work, giving them an overview of the FTC program and how a competition robot works. We also performed live demonstrations with the robot, highlighting the mechanisms, control systems and how it is used in matches. The visitors had the opportunity to interact directly with the robot, ask questions and learn more about the construction, programming and testing process. The interest and enthusiasm of the students contributed to a dynamic and energetic atmosphere throughout the event.

Participating in Şaguna Fest represented an important opportunity for our team to promote robotics among students and to celebrate, together with the school community, the 175-year tradition and performance of our college.

25.11.2025-27.11.2025

ROBOAS #19082

FORD BRASOV 15 YEARS ANNIVERSARY

On the occasion of the 15th anniversary of Ford Romania – Brașov, we had the honor of participating in the event dedicated to this important moment. The invitation represented a valuable opportunity to present our activity to a professional environment from the automotive and technological industry.

During the event, we performed demonstrations with our robot, highlighting the control systems, mechanisms, and the level of development achieved in the FTC competitions. Visitors had the opportunity to interact directly with the robot and learn more about the design, programming, and testing process behind it.

Participating in this event gave us the chance to promote robotics outside of the educational environment and show how a passion for technology can be transformed into real projects. At the same time, it was a motivating experience for the team, giving us the opportunity to interact with an audience interested in innovation and engineering.

12.12.2025

ROBOAS #19082

CARPATHIAN ROBOTICS LEAGUE MEET

The RoboAS team organized, together with AICitizens, CyberLIS and VVRobots, the first ever League Meet hosted in Brașov – Carpathian Robotics League Meet. For us, this event was of great importance, representing an important step in the development of the team and an opportunity to actively contribute to the growth of the FTC community in Romania.

The event brought together teams from the FIRST Tech Challenge Romania community in a competitive and collaborative setting, offering the opportunity to play matches, test robots and share experiences in a dynamic environment. Its organization involved a lot of work from our team, but also great satisfaction at the end, seeing the positive impact on all participants.

31.01.2026

ROBOAS #19082

FTC SHOWCASE INNOVATE AWARD

On February 28, we collaborated with Eastern Foxes in an online session where we presented our team, shared our journey toward earning the Innovate Award, and discussed the strategies, documentation practices, and key lessons that contributed to our success.

During the presentation, we also offered practical advice for teams interested in improving their engineering documentation and award submissions.

On March 8, the Innovate Award Guide developed in collaboration with Eastern Foxes was published on FTC Radar, making it available to the FTC community. The guide includes key steps, strategies, and best practices for applying for the Innovate Award, as well as lessons learned from successful teams, helping others improve their documentation and competition performance.

28.02.2026

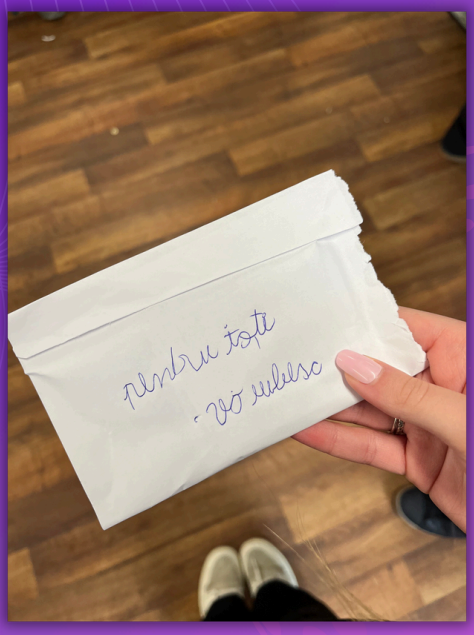
ROBOAS #19082

FIRST STEP TOWARDS STEM

On April 3, we had the opportunity to interact with the students of grade 2 from Secondary School No. 5 Săcele, to whom we presented the FTC program and our passion for robotics. The activity was designed as a friendly introduction to the world of technology, adapted to their age, so as to arouse their interest and curiosity.

During the meeting, I explained in a way that they could understand how a competition robot works and what it means to be part of a robotics team. I emphasized the importance of innovation, teamwork, and perseverance, showing them how ideas can become reality through work and collaboration.

In the end, we were happy to see how involved and curious they were, the activity giving us, as a team, the satisfaction of inspiring a younger generation and further promoting the passion for STEM and robotics.



03.04.2026

ROBOAS #19082

VISITING IAR

We had the opportunity to visit IAR Brașov, an emblematic place for the aeronautical industry in Romania, where engineering truly takes flight. The visit gave us valuable insight into how helicopters are designed, assembled and maintained, as well as the complexity of the processes behind each technical detail.

During the tour, we discovered the essential components of a helicopter and better understood how important precision is in every stage of construction, from design to testing and maintenance. Each element has a clear role in ensuring performance and safety, and attention to detail is essential in this field.

The experience was educational and inspiring, giving us the opportunity to see how engineering principles are applied on a real scale in the aeronautical industry. It was an activity that helped us make the connection between robotics and its real-world applications.

07.05.2026

ROBOAS #19082

HIGH SCHOOL FAIR

On May 8th and 9th, we participated in the High School Fair organized by the Institute of Research and Development of Transilvania University in Brașov. The event was an excellent opportunity to present both the activity of our team and the educational opportunities offered by the National College "Andrei Șaguna" to future high school students.

During the two days, we interacted with over 200 eighth grade students, to whom we presented the FIRST Tech Challenge program and the experience of being part of a robotics team. We told them about the competitions, about the process of building and programming a robot, but also about the skills we develop through participation in the FTC, such as teamwork, leadership, communication and engineering thinking.

At the same time, we promoted STEM values and shared the results achieved by our team over the years, demonstrating that performance is possible when there is passion, dedication and the desire to learn.

We hope that the experience offered at the fair inspired future high school students to follow their passions, explore the field of technology and choose an educational path based on innovation, creativity and continuous development.

08.05.2026-09.05.2026

ROBOAS #19082

FIRST STEPS IN ROBOTICS AND INNOVATION

The “First Steps in Robotics and Innovation” event was dedicated to children eager to discover the world of technology and robotics in an interactive and accessible way. Through practical activities, demonstrations and discussions, participants had the opportunity to learn more about how robots work and the principles that underlie them.

During the event, children explored basic STEM concepts, asked questions and interacted with our team members, discovering that robotics means much more than technology: it means creativity, collaboration and the desire to find innovative solutions. Their enthusiasm and curiosity turned each activity into a memorable experience.

We are glad that we had the opportunity to contribute to the development of interest in science and technology among young children and we hope that this experience has given them the inspiration to continue exploring and learning.

01.06.2026

ROBOAS #19082

BRASOV MARATHON

From May 30 to June 1, the RoboAS and KronBOT teams were present at the Brașov Marathon, one of the most important sporting events organized in the city. During the event, we had a stand where we interacted with hundreds of participants and visitors, giving them the opportunity to discover more about the activity of the robotics teams and the impact of the FIRST Tech Challenge program on the development of young people. During the three days, we presented the robots built by our teams, conducted interactive demonstrations and answered questions from those interested in technology, engineering and robotics competitions. The event gave us the opportunity to promote STEM values and show how passion, creativity and teamwork are transformed into complex technical projects.

Participating in the Brașov Marathon allowed us to reach a diverse audience, promote robotics outside of the competitive environment, and strengthen the connection between the local community and educational projects based on technology and innovation.

30.05.2026-01.06.2026

ROBOAS #19082

PAPER AIRPLANES

On June 13, 2026, the “Paper Airplanes” event took place, organized in support of the RoboAS and KronBOT robotics teams. The event brought together local community members, families, children, and education advocates for a day dedicated to creativity, technology, and community involvement.

Participants had the opportunity to take part in paper airplane competitions, robot demonstrations, recreational and educational activities, as well as artistic moments that contributed to the special atmosphere of the event. Interactive stands and demonstrations prepared by the two teams gave visitors the opportunity to discover more about robotics, programming, and the process behind participating in FIRST Tech Challenge competitions.

"Paper Planes" once again demonstrated the power of a community united around a common purpose. Through the involvement of participants, partners and volunteers, the event became more than just a recreational activity, transforming into a celebration of education, collaboration and passion for technology.

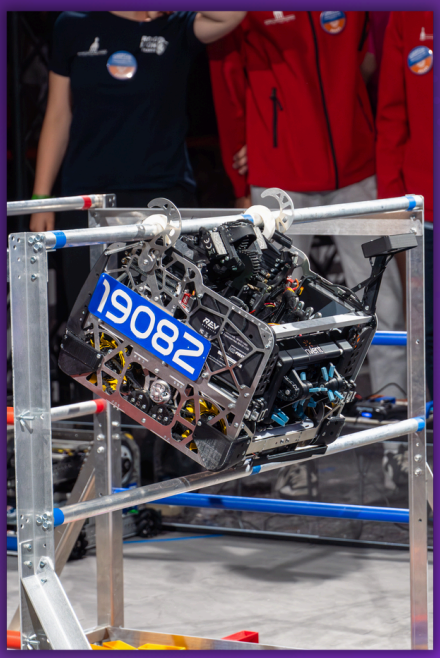
13.06.2026

4. COMPETITIONS

Innovation Design Creativity Impact Problem-solving STEM Build

EUROPEAN PREMIER EVENT

Following the results obtained at the national stage, we qualified for the European Premier Event by winning the Innovate Award 1. For this competition, we continued the development and optimization process of the robot, adapting it for the game on samples. Compared to the version used at the National, we integrated a Limelight system to improve the autonomous routine, implemented auto-alignment functionalities during the TeleOp period and made numerous optimizations aimed at providing more precise and efficient control of the robot.



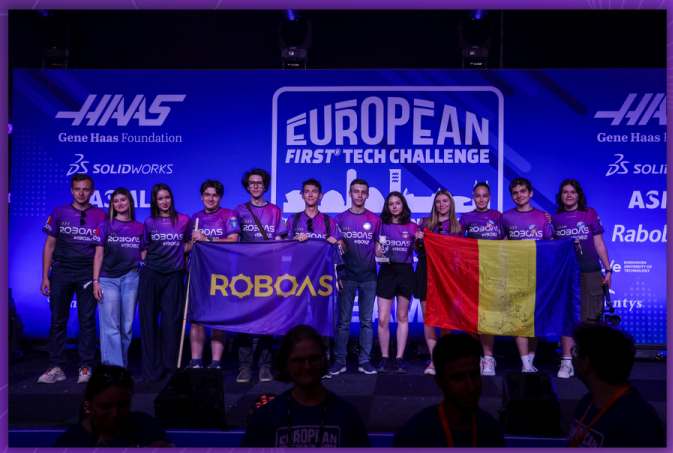
Before the competition started, we had the opportunity to take a guided tour of Eindhoven University of Technology. Students showed us around the faculties, extracurricular projects, workshops and available resources, giving us a valuable insight into the academic and technological environment. We also visited the Next Nature Museum, where we explored exhibitions dedicated to the relationship between technology, innovation and the future.

ROBOAS #19082

EUROPEAN PREMIER EVENT

The competition brought together over 90 teams from all over Europe, divided into two divisions, giving us the chance to compete at the highest level. During the qualifiers, we won 9 out of 10 matches, a performance that allowed us to become the captains of the Alliance number 3. For the playoffs, we formed an alliance with ByteForce, a team with whom we collaborated excellently both on and off the field.

Participating in the European Premier Event was an unforgettable experience. We had the opportunity to collaborate with teams from different countries, exchange ideas, and build new friendships within the international FTC community. The high level of competition and the connections we made throughout the event made this experience truly special. At the end of the competition, we finished the championship in 3rd place, a result that made us proud to have represented Romania on the European stage and which demonstrated once again the value of the work and dedication of the entire team.



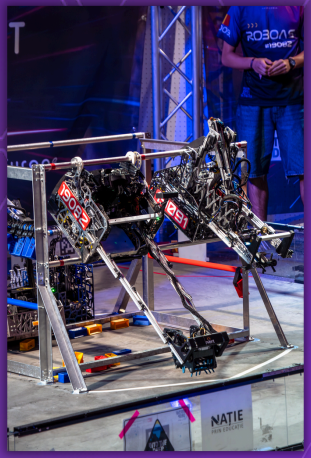
ROBOAS #19082

BUCHAREST TWIN CUP

At BTC, we formed an alliance with the team The Resistance. For both teams it was the first time participating in this event, which made the experience more interesting, as we entered a new context, without previous experience in this type of competition. Although we did not manage to qualify further from the qualifications stage, the competition was valuable for both sides, giving us the opportunity to continue optimizing our bots and play the last matches of the season in a competitive, but relaxed environment.

Along the way, we were able to test various improvements and strategies, and this was reflected in our match performances, where we achieved scores of over 500 points some of our best results of the season. This clearly showed us the progress we made throughout the year and gave us confidence in the solutions we implemented.

We also had the opportunity to interact with international teams, including from Texas, with whom we became friends and discussed robots, strategies and experiences in FTC. The atmosphere was very open, and the exchange of ideas with other participants was extremely valuable for us, giving us new perspectives on the game and how to approach competitions.



ROBOAS #19082

BOLTS&SPEED

The Bolts and Speed competition was an exciting and highly educational experience for our team, where we had the opportunity to explore the fundamentals of designing and building a small, high-performance vehicle. The challenge included multiple types of courses, such as speed tracks, off-road sections, and rally-style obstacles, which required us to constantly adapt our design and driving strategy.

Throughout the preparation and competition, we focused on improving both the mechanical design and the control of the vehicle, testing different solutions and iterating quickly based on performance. This process helped us strengthen our engineering skills, problem-solving abilities, and teamwork, as every decision had to be made collaboratively under time constraints.

We are especially proud of achieving the Best Overall Award, which recognized our consistency, creativity, and performance across all challenges. This achievement reflected the effort and dedication invested by the entire team and made the experience both rewarding and memorable.

ROBOAS #19082

ROBOTICS DAYS #4 EDITION SOUTH-EAST

On November 29, 2025, we participated in the Robotics Days #4 Edition – South-East League Meet, held in Ploiești and organized by BotsBrave, Info(1) Robotics, Eastern Foxes and Ro2D2 Team.

This was the first League Meet we attended in the DECODE season, representing an important moment for our team. It was the perfect opportunity to test our robot in real competition conditions, to familiarize ourselves with the challenges of the new season and to evaluate the results of the work done up to that point.

During the competition, we managed to achieve an exceptional result, ranking 1st and obtaining the Event High Score alongside the Undefined team. This performance reflected the dedication, perseverance and effort of the entire team in preparing for the season.

In addition to the competitive part, the event gave us the chance to meet again with members of the FIRST Tech Challenge community, to exchange ideas and experiences and to enjoy the passion for robotics together.

ROBOAS #19082

2025 DECODERA: RUBIX VERSION

On December 13 2025, we participated in the DecodeRA: RUBIX Version League Meet, held in Blaj, a successful event organized with the involvement of the Alphatronic and RUBIX teams. The competition brought together numerous teams from the FTC community, giving us the opportunity to test our robot, strategies and collaboration capacity in a competitive environment.

During the 15 matches played, we encountered technical and tactical challenges that tested our adaptability and team spirit. Each match was an opportunity to learn, identify aspects that could be improved and capitalize on the strengths of our robot. Thanks to constant preparation and efficient collaboration between team members, we managed to obtain 1st Place in the final ranking.

This result had a significant impact on the team, confirming that the work done during the season produces results and giving us the motivation to continue evolving. The competition allowed us to analyze different playing styles, observe the technical solutions implemented by other teams, and discover new strategies that we can adapt in the future.

ROBOAS #19082

2025 DECODERA: ALPHATRONIC VERSION

On January 17 2026, we participated in DecodeRA: Alphatronic Version, held in Cluj-Napoca, a League Meet organized by the Alphatronic and RUBIX teams. This event represented an important stage in our competitive journey, giving us the opportunity to put into practice the improvements made after the previous competitions.

In addition to obtaining 2nd Place, participating in this League Meet helped us better manage our preparation time between matches, coordinate more effectively within alliances, and better understand the role of each member during the competition. We also had the opportunity to observe the evolution of other teams, as well as our own, and discover new perspectives on how to approach the game this season.

The experience gained in Cluj contributed to strengthening our confidence in our own abilities and preparing for the next stages of the season.

SIGNAL OF LOVE

On February 14 2026, we participated in the Signal of Love League Meet, held in Mediaș and organized by the Gear Maniacs and The Resistance teams. During the competition, we played 6 matches, each one giving us the opportunity to test our robot and adapt to different game situations.

Although we encountered various challenges during the matches, the experience gained helped us identify aspects that could be improved and to focus on the continuous development of the team. The results obtained motivated us to work even harder to achieve our goals.

At the same time, the event had a special atmosphere, giving us the opportunity to spend Valentine's Day with other teams passionate about robotics, strengthening the community spirit that characterizes the FTC program.

ROBOAS #19082

ROMANIA CENTRAL TOURNAMENT

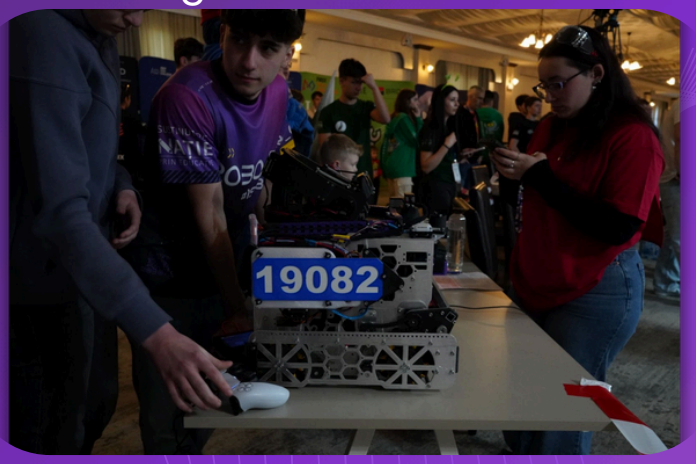
Between February 28 and March 1, we participated in the regional FIRST Tech Challenge held in Alba Iulia. The competition brought together some of the strongest teams from the central area of the country, giving us the opportunity to test our robot, strategies, and training accumulated throughout the season.

During the competition, we played intense matches and encountered various challenges that tested our ability to adapt and collaborate. After a difficult start, we analyzed the situation, adjusted our strategy and managed to constantly improve our performance from match to match. In addition to the qualifying matches, the RoboAS team was selected by the CyberPunk team of the “Mihai Viteazul” National College, Turda to play in the play-offs for a better place in the qualification for the national stage. After some difficult moments in the qualifications, they changed their strategy and managed to have a path that they are proud of.

ROBOAS #19082

ROMANIA CENTRAL TOURNAMENT

In the end, RoboAS demonstrated that innovation on the robot, elegant design, consistency and creativity were the basic principles for excellence and qualification at increasingly challenging stages, winning the Innovate Award again this year. This award highlighted not only the team's technical skills, but also the ability to think strategically, to document each stage of the project and to transform original ideas into functional solutions on the ground. At the same time, it confirmed the perseverance, close collaboration between the members and the passion for robotics, reaffirming the constant desire to innovate and preparing the team to successfully face the challenges of the next stage.



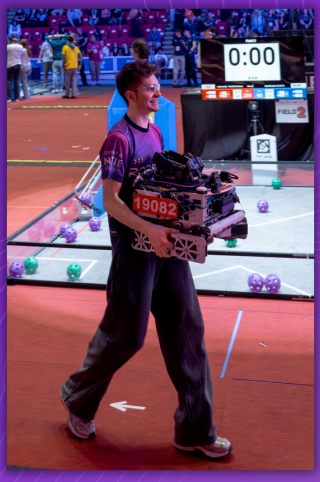
Participating in this competition was a wonderful experience for the entire team. We learned new things, gained valuable experience, and enjoyed the competitive atmosphere alongside other teams passionate about robotics. This experience motivated us to continue developing and constantly improving.

NATIONAL CHAMPIONSHIP

The Romanian National Championship of the FIRST Tech Challenge competition took place in Bucharest, in the Multipurpose Hall, from March 13 to 15. The edition marked 10 years of FTC in Romania, celebrating a decade of innovation, excitement and the development of a community united around the passion for technology.

The competition was attended by 96 teams from all regions of the country, divided into two divisions, Vlaicu and Coandă. Over the three days, the matches were intense and full of energy, in an atmosphere that highlighted both technical performance and team spirit.

The RoboAS team, representing the “Andrei Şaguna” National College in Braşov, demonstrated once again that performance is built through work, passion and determination. Although the journey was full of challenges, the team managed to constantly adapt and come back stronger at each stage of the competition.



NATIONAL CHAMPIONSHIP

At the national stage, the team won 3 out of 6 qualifying matches and again won the Innovate Award, its fifth consecutive time in the last two years. RoboAS finished the competition in 34th place, in the top half of the rankings. Although it did not qualify for the international stages, the team's journey continued with the same ambition, with plans to participate in Premier Events and further demonstrate its potential at the international level.

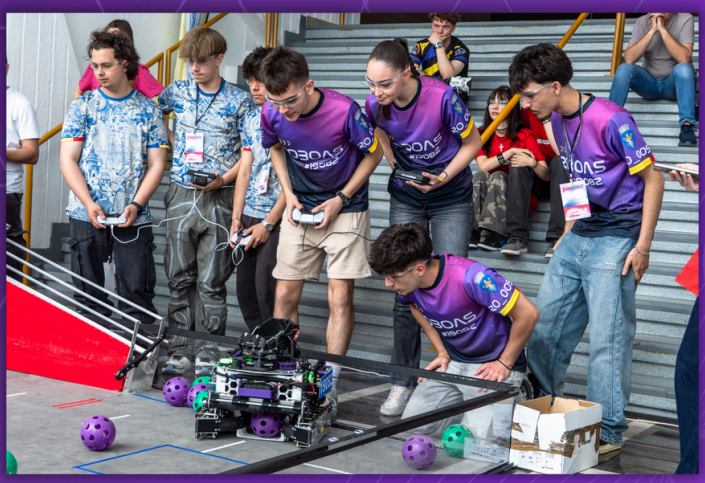
Thus, RoboAS remains an example of perseverance, creativity and team spirit. Over time, the team has shown that success does not depend only on technology, but also on collaboration, sustained work and a constant desire to evolve. Each season brought new challenges, and the team always responded with innovation and determination, inspiring the robotics community and demonstrating that passion can turn obstacles into opportunities for growth.

ROBOAS #19082

ROBOTICS SUMMER FEST

On May 30th, we attended Robotics Summer Fest, an event organized by the BotsBrave team, which brought together numerous FTC teams in a setting that combined competition, technology, and recreational activities. This was the first off-season competition we participated in after the end of the Decode season, giving us the opportunity to get back on the field and continue to develop our technical and strategic skills.

A highlight of the event was the collaboration with the Bolts & Gears team, with whom we achieved our second Event High Score. This result demonstrated the efficiency of the collaboration between the two teams and reflected the level of preparation, coordination and adaptability during the matches.



Beyond the competitive aspect, Robotics Summer Fest offered a pleasant and relaxed experience, complemented by artistic moments and special activities that contributed to the atmosphere of the event. Participating in this competition allowed us to start the off-season in a positive way and continue to enjoy the FTC experience alongside other teams.

2025-2026 SEASON

5. PLANS FOR DEVELOPMENT & MANAGMENT

Innovation Design Creativity Impact Problem-solving STEM Build

RO_009

#19082 DECODE

ROBOAS #19082

OUR BUDGET

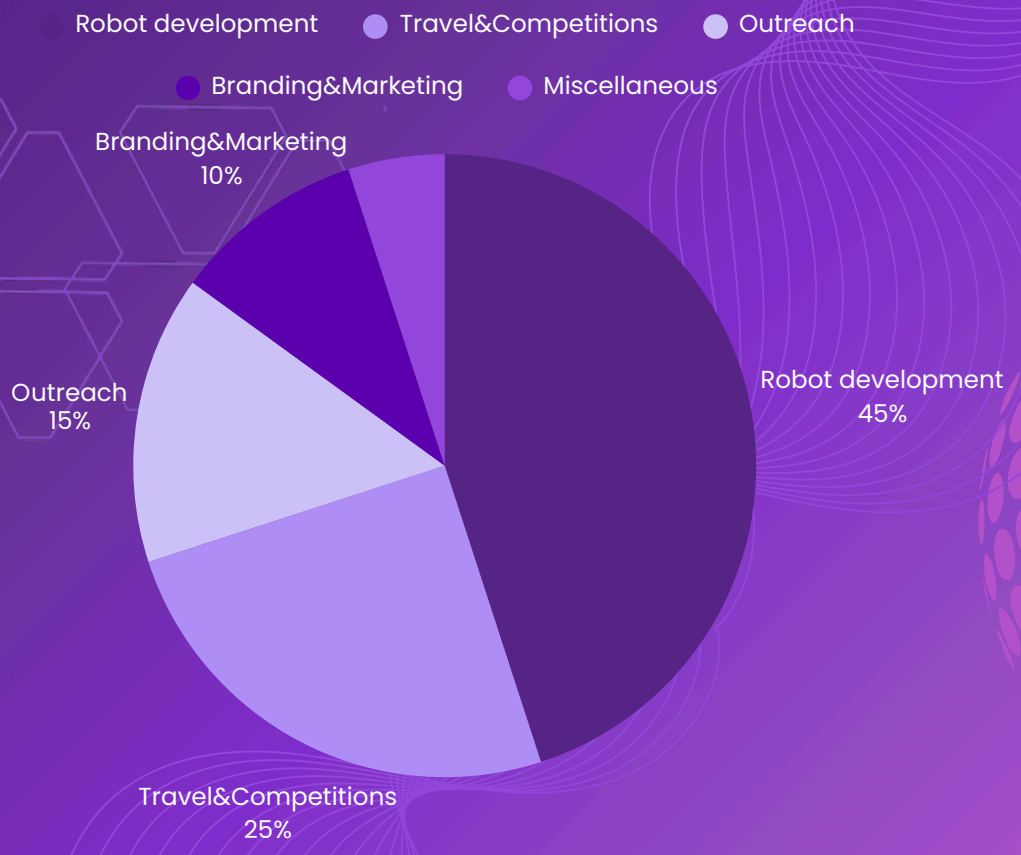
Participating in FIRST Tech Challenge requires careful financial planning and responsible resource management. Throughout the season, our budget supported every aspect of the team's activity, from robot development and competition participation to outreach events and team growth.

MAIN EXPENSE CATEGORIES

- **Robot Parts & Materials**
- **Electronics & Sensors**
- **Manufacturing & Prototyping**
- **Competition Registration**
- **Travel & Accommodation**
- **Outreach Events**
- **Team Branding & Promotional Materials**
- **Workshop Equipme**

MAIN SOURCES OF FUNDING

- **Sponsors**
- **Partners**
- **Fundraising Events**
- **Community Support**
- **Donations**
- **Team Projects & Initiatives**



ROBOAS #19082

THE EVOLUTION OF THE BUGET IN TIME

Over the years, our team's budget has grown alongside our ambitions and achievements. What started as a small budget focused mainly on basic robot components has gradually evolved into a more complex financial structure that supports robot development, outreach activities, competitions, workshops, and international events.

Over the past two seasons, our budget has grown significantly, reflecting both the development of our team and the increasing trust of our sponsors and partners. Through continuous outreach, stronger community engagement, and improved sponsor relationships, we were able to secure more resources to support our goals.

SEASON	SPONSORSHIP BUGET(€)
Last Season, Before National Championships: Sponsorships	**8120**
Last Season, Before Netherlands Premier Event: Sponsorships	**15000**
This Season, Before National Championships: Sponsorships	**33000**
This Season,Before Istanbul Premier Event: Sponsorships	**10000**

SPONSORS & PARTNERSHIPS

Sponsors and partners play an essential role in the development of our team, offering not only financial support but also resources, expertise, and opportunities that help us achieve our goals.

Over the years, RoboAS has built strong, long-term relationships with local companies, educational institutions, and community organizations, creating a reliable network that supports our mission of promoting STEM education and innovation.
This support has allowed us to improve our robot, develop our workshop, participate in competitions, and expand our outreach activities. It has also helped us organize events and reach a wider audience interested in robotics and technology.

For us, every partnership represents a shared commitment to education, innovation, and the growth of future generations, helping our team continue to evolve and make an impact in the community

IMPACT

- **Increased sponsorship budget year after year**
- **Expanded outreach activities**
- **Improved workshop resources**
- **Participation in national and international events**
- **Stronger connections with the local community**

SPONSORS & PARTNERSHIPS

BRASOV COMMUNITY FOUNDATION

BRAŞOV COMMUNITY FOUNDATION's mission is to develop philanthropy and encourage civic initiative at the level of Brașov County, by financially supporting local projects in various fields, such as education, social inclusion, environmental protection, culture, animal protection or urban revitalization.
It contributes to building solidary, responsible and action-oriented communities, in which local initiatives come to life, aiming at the joy of living and evolving together in the Brașov area.

NVENT

nVent Brașov is part of nVent, a global company specializing in electrical connection and protection solutions. The company develops products and systems that help protect electrical equipment, improve safety, and ensure reliable operation in industries such as energy, infrastructure, and manufacturing. Through innovation and engineering excellence, nVent contributes to building a more sustainable and electrified world.

ARABESQUE

Arabesque Brașov is part of Arabesque, one of the largest distributors of construction materials and finishing products in Romania. The company provides a wide range of solutions for residential, commercial, and industrial projects, serving both professionals and individual customers. Through its extensive network and experience in the field, Arabesque plays an important role in supporting the construction industry.

SPONSORS & PARTNERSHIPS

KRONOSPAN

Kronospan is a global manufacturer of wood-based panels and interior design materials, serving industries such as furniture production, construction, and interior design. Kronospan is known for producing particleboard, MDF, laminate flooring, and decorative surfaces, combining innovation with sustainable manufacturing practices. Through continuous investment in technology, the company provides high-quality solutions used in projects around the world.

SIEMENS

Siemens is a global technology company focused on industry, infrastructure, mobility, and digitalization. Siemens develops innovative solutions in areas such as automation, smart infrastructure, energy systems, and software, helping improve efficiency and sustainability across multiple industries. With a strong emphasis on engineering and technological innovation, Siemens contributes to shaping the future of industry and society.

AUTOLIV

Autoliv is a global leader in automotive safety systems, dedicated to developing technologies that save lives and prevent injuries in traffic accidents. Autoliv designs and manufactures products such as airbags, seatbelts, and steering wheel systems for vehicle manufacturers worldwide. Through continuous research and innovation, the company contributes to making transportation safer for millions of people every day.

SPONSORS & PARTNERSHIPS

3DDOT

3D DOT is a company specialized in 3D printing and additive manufacturing solutions. 3D DOT provides rapid prototyping, custom manufacturing, and technical consulting services, helping transform digital designs into physical products. Through advanced technologies and innovative production methods, the company supports projects in engineering, education, and product development.

FILAMENTE3D

Filamente3D is a Romanian company specialized in 3D printing products and solutions. Filamente3D offers a wide range of filaments, 3D printers, accessories, and technical equipment for makers, educational institutions, and engineering teams. By providing high-quality materials and expertise, the company supports innovation, prototyping, and technological development.

BUCHAREST COMMUNITY FOUNDATION

The Bucharest Community Foundation is a non-profit organization that supports community initiatives, educational projects, and social innovation in Bucharest and Ilfov. By connecting donors, companies, NGOs, and local leaders, it provides funding and resources for projects that create a positive impact and improve life in the community. Since its founding, the organization has supported hundreds of projects and scholarships, promoting civic engagement, education, and sustainable development.

SPONSORS & PARTNERSHIPS

TEAMGANTT

TeamGantt is a project management software company that provides intuitive tools for planning, scheduling, and tracking projects through interactive Gantt charts. TeamGantt helps teams organize tasks, manage timelines, and collaborate more efficiently, ensuring that projects stay on schedule. Its user-friendly platform is used by organizations worldwide to improve productivity and streamline project management processes.

UBRIS

Ubris is a company focused on technology and engineering solutions, supporting innovation through services such as software development, digital systems, and technical expertise. Ubris works with clients to deliver customized solutions that improve efficiency and performance across different projects. Through its focus on modern technologies and problem-solving, the company contributes to digital transformation and innovation in various industries.

KASPER

Kasper Association is a non-profit organization focused on supporting education, youth development, and community projects. Kasper Association is involved in initiatives that promote learning opportunities, social engagement, and personal growth for young people. Through its activities and partnerships, the organization contributes to building stronger communities and encouraging active involvement in educational and social programs.

SPONSORS & PARTNERSHIPS

HOLVER

Holver is a Romanian company specialized in wood-based panels and furniture materials used in construction and interior design. Holver supplies products such as plywood, MDF, chipboard, and other wooden components for furniture manufacturing and architectural projects. Through its focus on quality materials and reliable distribution, the company supports both industrial and custom woodworking projects.

CITY HALL OF BRASOV

Brașov City Hall is the local public administration authority responsible for managing the city of Brașov. Brașov City Hall oversees urban development, public services, infrastructure projects, and community programs aimed at improving the quality of life for residents. Through its initiatives and support for local events and organizations, it plays an important role in the social, cultural, and economic development of the city.

DIGITAL BRAIN

Digital Brain focuses on creating custom digital solutions, supporting clients in areas such as web development, software engineering, and digital transformation. Through its expertise, the company helps improve efficiency and innovation in various industries.

SPONSORS & PARTNERSHIPS

LUADO

Luado Chocolate is a Romanian artisan chocolate brand that focuses on creating high-quality handmade chocolate products. Luado Chocolate is known for its attention to detail, premium ingredients, and creative recipes, offering a variety of chocolate treats that combine taste, aesthetics, and craftsmanship.

ICEBERG+

Iceberg+ is an innovation and technology hub that supports startups, research, and digital transformation projects in Romania. Iceberg+ focuses on connecting businesses, universities, and public institutions to foster entrepreneurship, education, and technological development. Through its programs and partnerships, it helps accelerate innovative ideas and supports the growth of the local tech ecosystem.

ROUND TABLE 1 BRASOV

Round Table 1 Brașov is part of the international Round Table organization, a non-political and non-religious association of young professionals focused on community service and personal development. Round Table 1 Brașov is involved in organizing charitable actions, educational projects, and community events that support local initiatives and promote civic engagement.

SPONSORS & PARTNERSHIPS

M&M EXPRESS

M&M Express Brașov is a local logistics and transport company that provides courier and delivery services for both individuals and businesses. M&M Express Brașov focuses on fast and reliable transportation solutions, supporting efficient distribution of goods within Brașov and surrounding areas.

EUROKO

Euroko is a company involved in construction materials and industrial supply solutions, serving both professional and residential projects. Euroko provides a range of products used in building, renovation, and technical applications, supporting the development of infrastructure and construction projects through reliable materials and services.

CATTIA

CATTIA Brașov is a business and innovation center that supports entrepreneurship, research, and technology development in the region. CATTIA Brașov provides infrastructure, resources, and collaborative opportunities for companies, startups, and institutions working in innovation and applied research. Through its programs and partnerships, it contributes to strengthening the local innovation ecosystem and supporting economic development in Brașov.

ROBOAS #19082

OUR OBJECTIVES THROUGH SPONSORSHIPS

MAIN OBJECTIVES OVERVIEW

Objective Area	What Sponsorships Help Us Achieve
Robot Development	Purchase materials, improve mechanisms, integrate new technologies
Competition Participation	Cover registration fees, travel, and logistics for national & international events
Outreach & STEM Promotion	Organize workshops, events, and activities for students
Workshop Development	Improve tools, equipment, and working environment
Team Growth	Support training, mentoring, and member development

IMPACT OF SPONSORSHIPS

Area	Impact on the Team
Technical Growth	Better robot performance and innovation
Community Impact	More STEM events and student engagement
Competitive Performance	Higher-level participation in FTC events
Sustainability	Long-term stability and continuous improvement

2025-2026 SEASON

6. STRATEGY FOR MARKETING & PR

Innovation Design Creativity Impact Problem-solving STEM Build

RO_009

#19082 DECODE

OUR ONLINE PRESENCE

SOCIAL MEDIA

Our team maintains a strong digital presence across multiple platforms, including Instagram, Facebook, TikTok, LinkedIn, YouTube, and our official website. Through these channels, we share updates about our progress, competition results, outreach activities, and behind-the-scenes moments from our engineering and programming work. This consistent activity helps us stay connected with our community, engage with supporters, and increase the visibility of both our team and our partners.

PODCAST

We were invited by Team Rasky to participate in their podcast, where we shared our experience in FIRST Tech Challenge, our projects, and the impact of robotics on our team's development. This opportunity allowed us to present RoboAS to a wider audience and discuss topics such as teamwork, innovation, and STEM education.

We also participated in our school's podcast "InCasti," where we discussed our daily work as a robotics team, how we manage our roles, and what it means to be part of RoboAS. It was a great opportunity to present a more personal perspective on our activities and to connect with students from our school, showing them how STEM can be both educational and exciting.

OUR ONLINE PRESENCE

RADIO

We were invited to a live interview at Radio Brașov (Radio BV), where we discussed our activities as a robotics team and answered questions about how we organize our work and prepare for competitions.

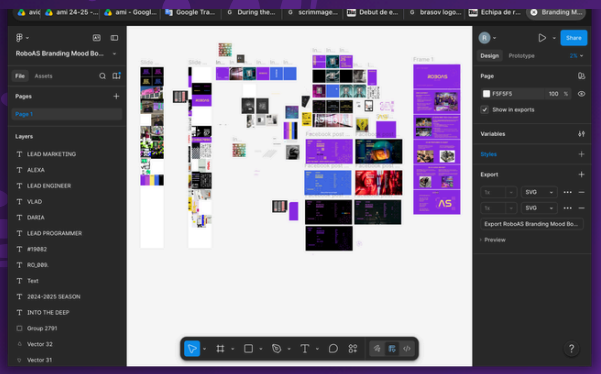
This experience also gave us the opportunity to better promote the events we have organized, reaching a wider local audience and increasing awareness about our initiatives. The interaction helped us present our team in a more dynamic way and engage more directly with the community.

LOCAL PRESS

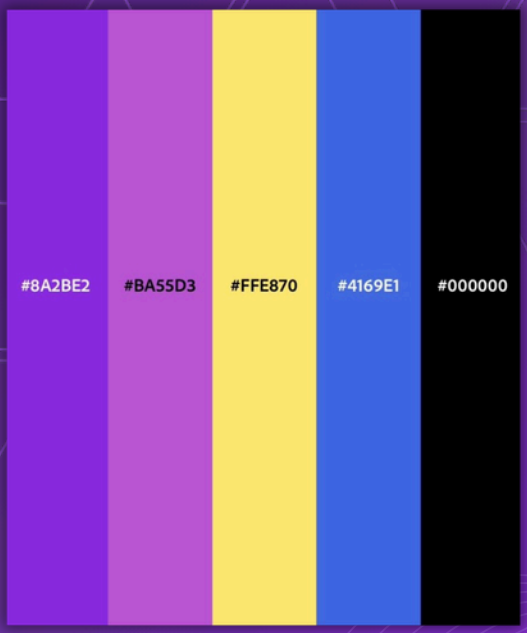
We also actively promote our activities through the local press, using media coverage as an opportunity to share our projects, achievements, and events with a wider audience. This helps us increase visibility in the community, highlight the impact of our work in robotics, and encourage more students to get involved in STEM activities.

OUR BRANDING

We use Figma as one of our main tools for developing and maintaining our team's visual identity. It allows us to design consistent branding elements such as logos, social media posts, presentations, and outreach materials.



By working collaboratively on Figma, our team ensures a unified and professional look across all platforms, strengthening RoboAS's recognition within the FTC community and beyond.



Our promotional materials play an important role in strengthening the RoboAS brand and ensuring a consistent visual identity across all our activities. We use banners, flyers, posters, stickers, team apparel, and digital graphics to promote our team, events, and achievements. Our branding is built around a distinctive color palette that is used consistently across our social media platforms, outreach materials, competition setup, and merchandise. By maintaining a unified visual identity, we increase the recognizability of our team and present a professional image to our community, sponsors, and partners.

ROBOAS #19082

MEASURING OUR IMPACT

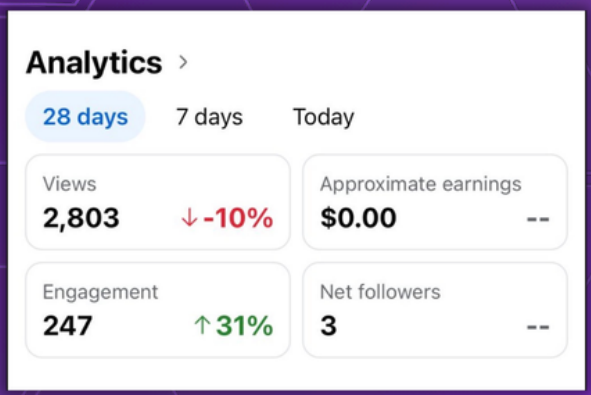
Monitoring statistics allows us to better understand the impact of our content and evaluate how effectively we communicate with our audience. By analyzing data from our social media platforms, website, media appearances, and outreach activities, we can identify opportunities for growth and improve our communication strategy.

STATISTICS

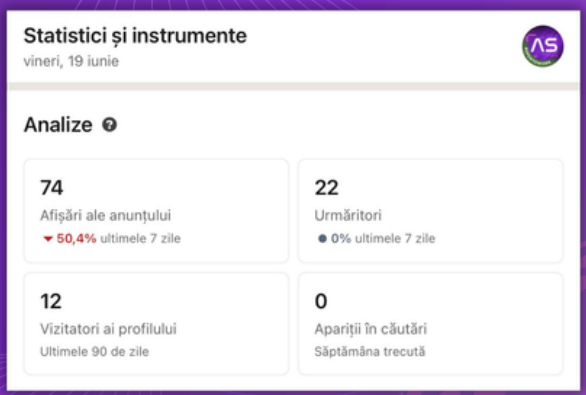
Instagram

TikTok

Facebook



LinkedIn



Statistics play an important role in guiding our decisions and setting future goals. By continuously monitoring our impact, we ensure that our efforts contribute to increasing awareness of RoboAS, promoting STEM education, and strengthening the connection between our team, our partners, and the wider community.

FUTURE GOALS

As RoboAS continues to grow, we aim to expand our impact both within and beyond the FIRST community. Our future objectives focus on increasing our outreach efforts, strengthening partnerships, growing our online presence, and creating more opportunities for students to engage with STEM and robotics. By setting ambitious goals and continuously improving our strategies, we hope to inspire even more young people and further establish RoboAS as a leading robotics team in our community.

Indicator	Current	Goal
Sponsors&Partnerships	21	30
Followers	1359/389/400/22	1700/500/700/200
Events	18	30
Students Reached	~300	~600

GENERAL GOALS

- Reach more students through workshops and school visits
- Develop new partnerships with companies and organizations
- Grow our digital presence across all social media platforms
- Participate in international events and represent our community abroad
- Expand STEM initiatives and inspire future generations of innovators

2025-2026 SEASON

7. ENGINEERING

Innovation Design Creativity Impact Problem-solving STEM Build

RO_009

#19082 DECODE

INTRODUCTION

Throughout the season, our robot underwent multiple iterations based on driver feedback, match observations, and testing results. Rather than adding complexity, we focused on improving reliability and consistency. Several mechanisms were redesigned to reduce failure points, improve serviceability, and increase overall scoring efficiency.

Each design change followed our engineering process: identify a problem, develop potential solutions, prototype and test, analyze results, and implement the best-performing option. This iterative approach allowed us to continuously refine the robot and adapt to the evolving competitive environment.

At the beginning of the season, we developed two modular test platforms to accelerate robot development. Rather than waiting for the final robot to be completed, these platforms allowed different subteams to work in parallel.

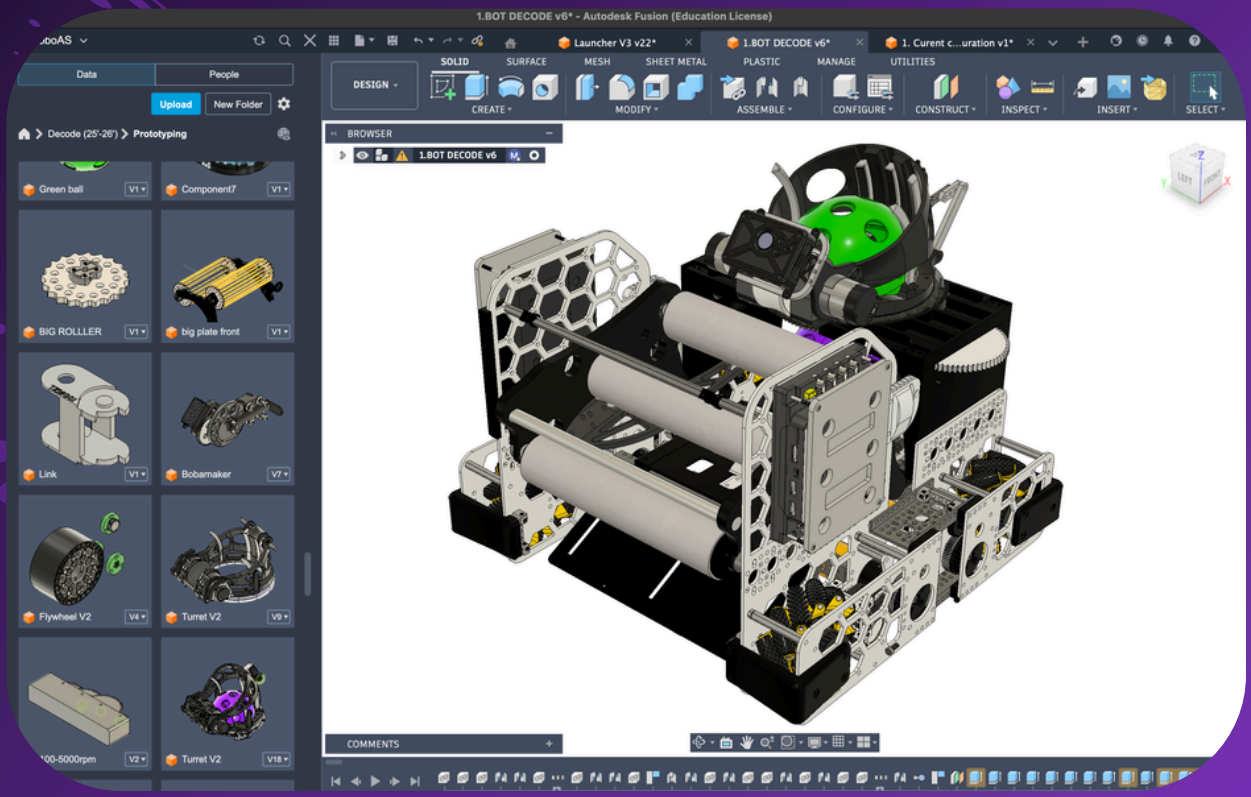
The primary goal was to enable software development while mechanical systems were still being designed and manufactured. Programmers could begin implementing and testing drivetrain control, sensor integration, autonomous routines, and other software features without depending on the availability of the competition robot.

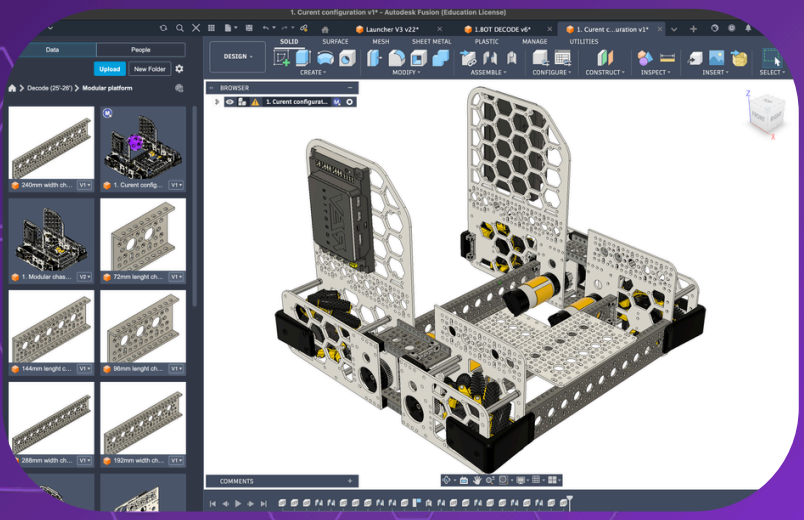
The modular design also allowed engineers to rapidly prototype and evaluate mechanisms before committing to a final design. Components could be easily added, removed, or modified, reducing iteration time and helping the team validate ideas more efficiently.

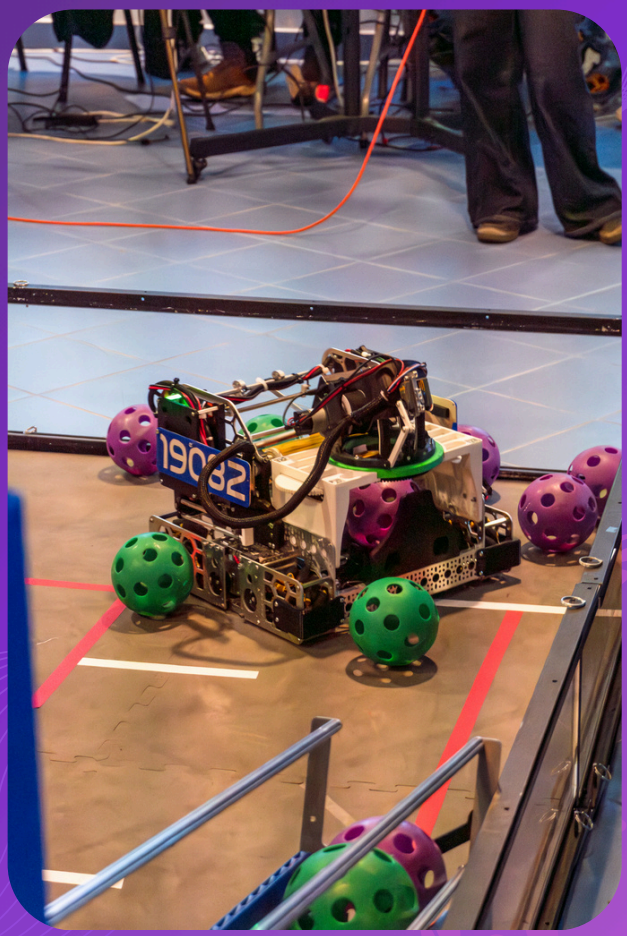
By separating software and mechanical development, we increased productivity across the team, shortened development cycles, and identified potential issues earlier in the engineering process.

ROBOAS #19082

THE PLATFORMS



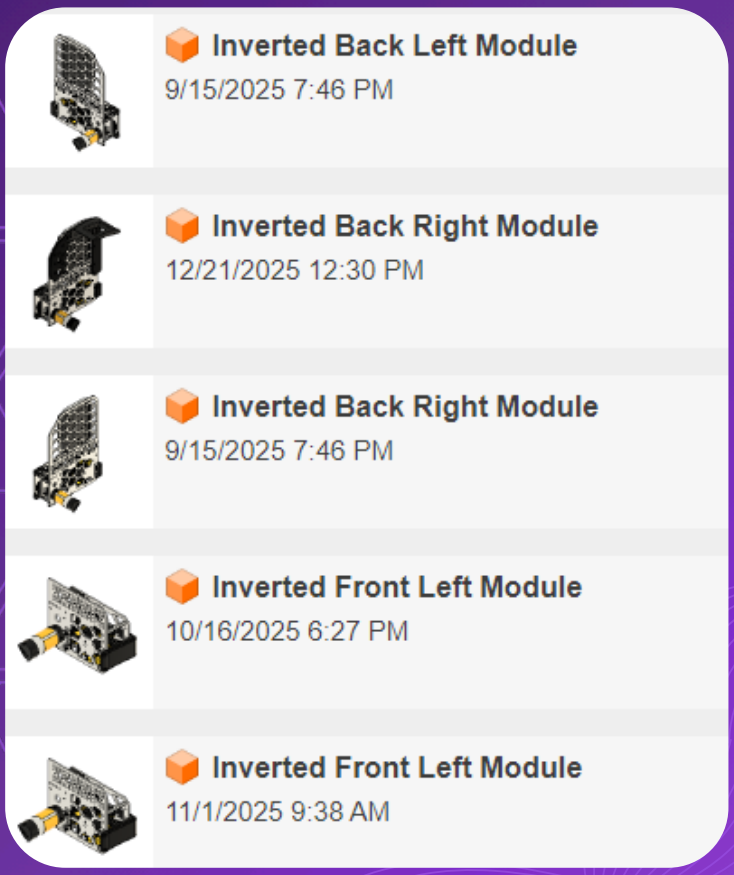


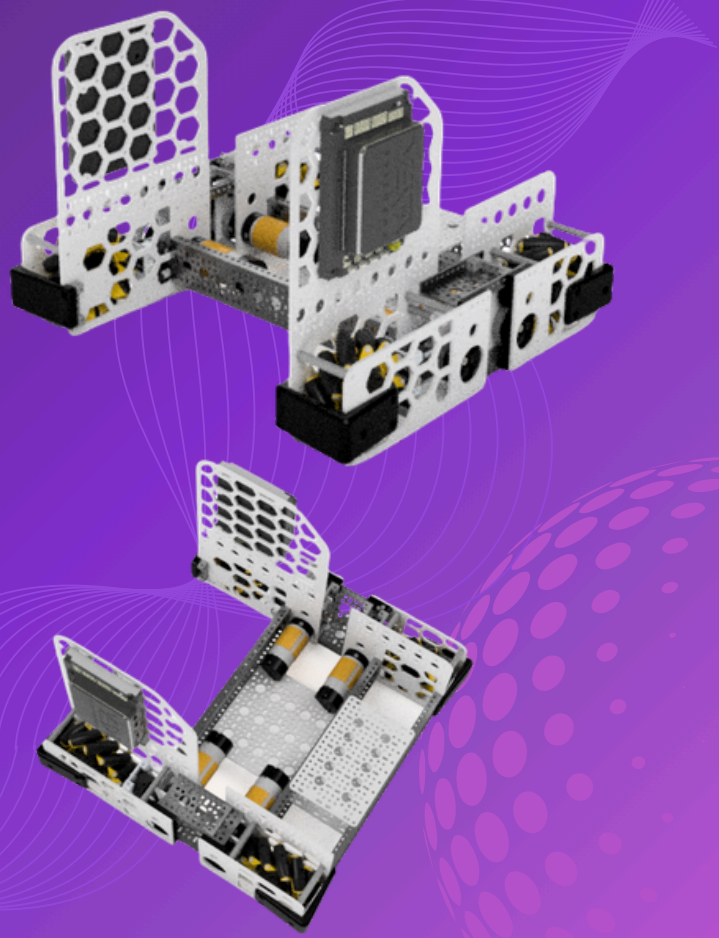


Although our development platforms use custom laser-cut side plates, they were designed with modularity as a primary objective. The chassis is divided into independent sections, with each wheel assembly forming its own module. This approach allows individual components to be modified, replaced, or tested without requiring a complete redesign of the entire structure.

The platforms also incorporate numerous goBILDA channels and mounting patterns, ensuring compatibility with standard FTC components. As a result, mechanisms can be quickly attached, adjusted, or removed using readily available goBILDA parts. This flexibility enables rapid prototyping and allows team members to begin developing mechanisms immediately, even before custom components are manufactured.

By combining custom structural elements with a highly modular architecture, the platforms provide both the rigidity needed for testing and the adaptability required for fast engineering iteration throughout the season.



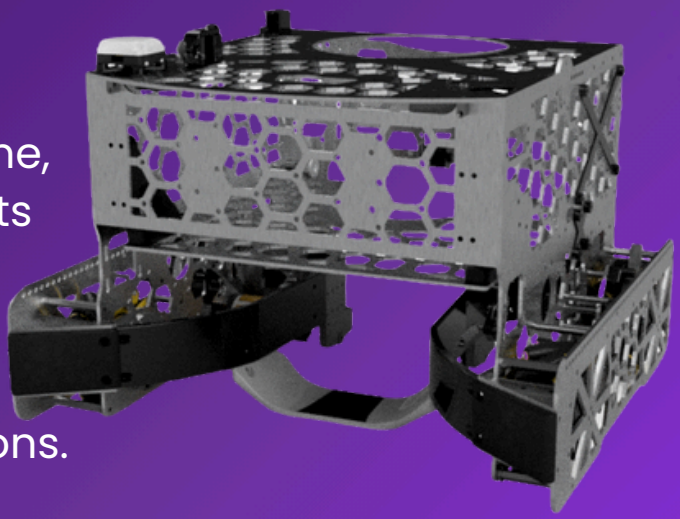


ROBOAS #19082

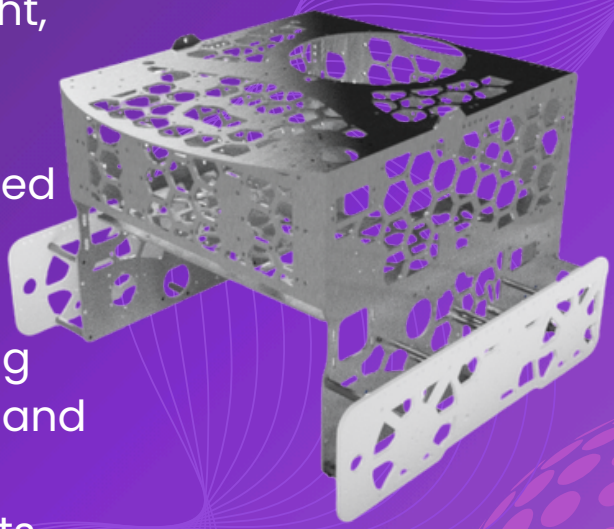
ABOUT LEGOLAS

CHASSIS

The chassis was designed around three main objectives: rigidity, modularity, and serviceability. To achieve these goals, we developed a structure composed of interlocking custom laser-cut aluminum plates connected through reinforced standoffs. The interlocking geometry distributes loads throughout the frame, reducing flex under defensive impacts while maintaining a lightweight structure.



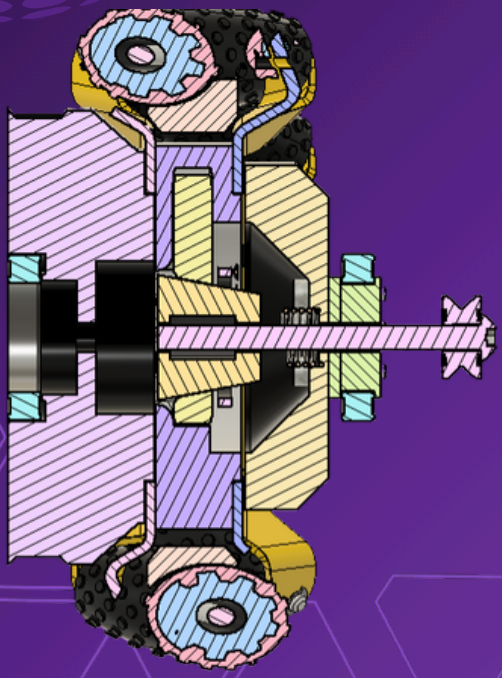
Throughout the design process, we evaluated several frame configurations. We determined that a plate-and-standoff architecture provided the best compromise between stiffness, weight, and manufacturing complexity. The modular layout allows individual subsystems to be removed or modified without redesigning the entire robot.

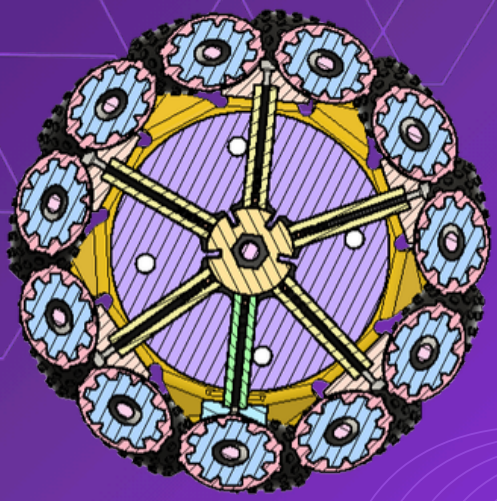


An additional design objective was maintenance efficiency. By organizing the robot into independent modules and standardizing mounting locations, repairs and component replacements can be performed rapidly during competitions. This approach allowed us to maintain structural integrity while reducing downtime between matches.

ROBOAS #19082

DRIVEBASE

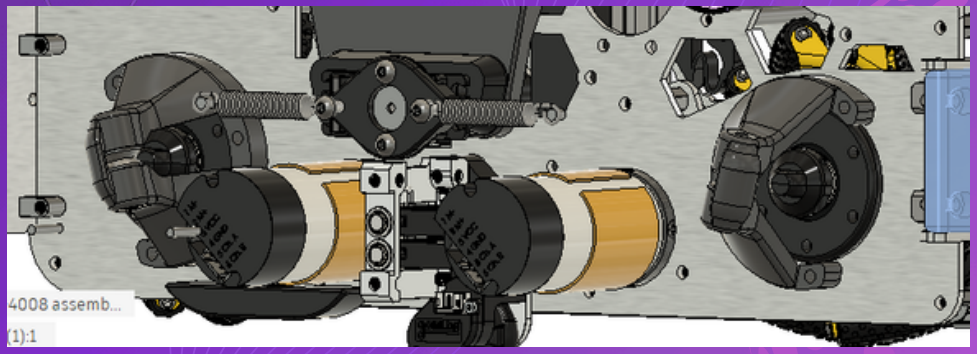




To maximize maneuverability, we selected a mecanum drivetrain capable of omnidirectional movement. This allows the robot to translate and rotate simultaneously, reducing alignment time during both intake and scoring operations.

During testing, we observed that mecanum wheels sacrifice pushing power because of their free-spinning rollers. To address this limitation, we designed a locking mecanum mechanism. A servo-driven linkage actuates a custom 3D-printed locking element that prevents the rollers from rotating freely. When engaged, the wheel behaves similarly to a traction wheel, significantly increasing pushing capability and stability.

This system allows the robot to dynamically switch between two operating modes: an agile omnidirectional mode for scoring cycles and a high-traction mode for defensive situations. By combining both capabilities in a single drivetrain, we avoided the compromises normally associated with mecanum robots.



INTAKE TRANSFER

Our intake system was designed to minimize cycle time by allowing game pieces to be collected from either side of the robot. A pivoting pedal mechanism automatically adapts to the intake direction, enabling front and rear acquisition without requiring the driver to rotate the robot. This significantly reduces unnecessary drivetrain movement and improves overall scoring efficiency.

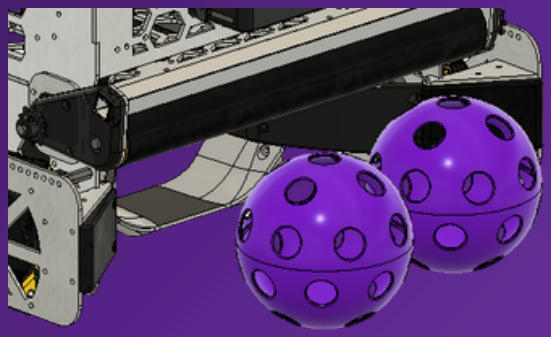
After entering the robot, game pieces are transported through a belt-driven transfer system that maintains controlled compression and consistent positioning. Several intake geometries were tested throughout the season. Early versions experienced reliability issues, excessive friction, and difficulties handling adjacent game pieces. Through iterative testing, we refined the roller geometry and transfer path to improve consistency and reduce jams.

Initially, the robot included a sorting mechanism intended to separate game pieces before launching. However, testing showed that the system increased cycle times and introduced additional failure points while providing limited strategic benefit. As the competitive meta evolved, scoring speed became more important than sorting capability. We therefore removed the sorter and replaced it with a fixed storage slot.

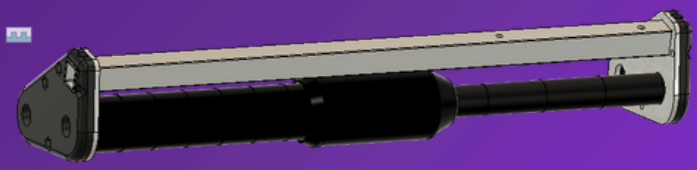
To improve reliability, we added multiple limit switches throughout the transfer path. These sensors provide accurate game-piece tracking and act as a safeguard against occasional proximity sensor misreads. The final design is simpler, faster, and significantly more reliable than previous iterations.

ROBOAS #19082

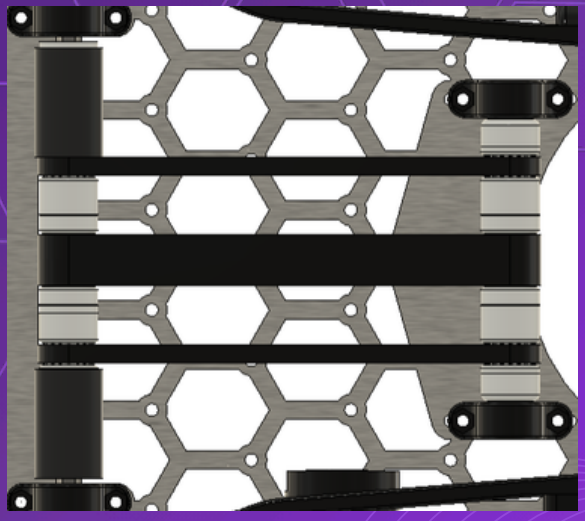
INTAKE TRANSFER

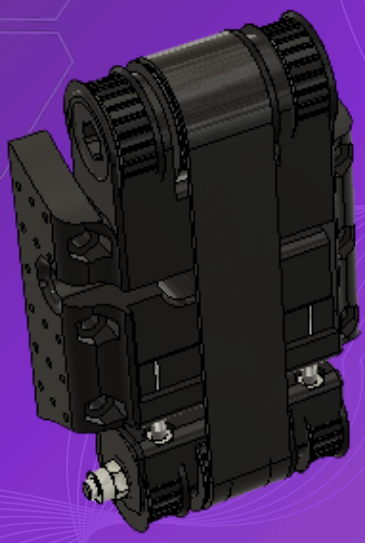


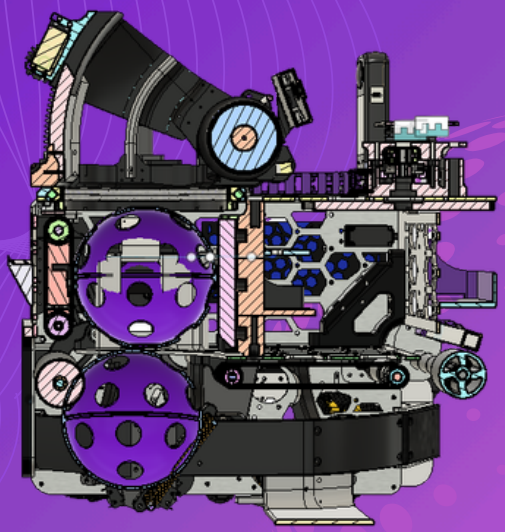
INTAKE VARIATIONS



THE CONVEYOR BELTS FOR TRANSFER







ROBOAS #19082

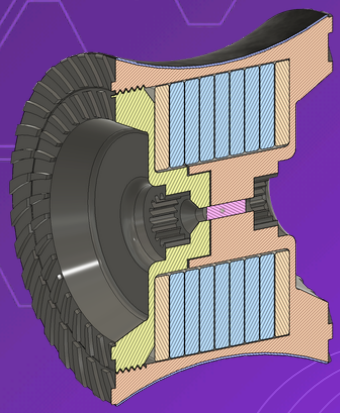
THE SHOOTER

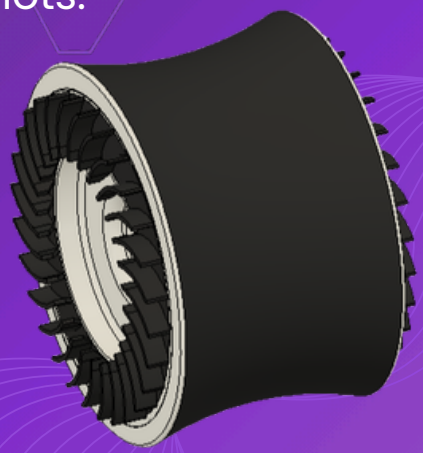
The shooter was one of the most critical subsystems on our robot because it directly influenced scoring consistency, cycle speed, and autonomous performance. From the beginning of the season, our goal was to create a launcher capable of maintaining repeatable trajectories regardless of game piece variation, robot position, or firing sequence.

Our development process involved multiple flywheel iterations. Early prototypes suffered from inconsistent compression, insufficient inertia, and excessive sensitivity to differences in game piece geometry. Testing showed significant variations in exit velocity between consecutive shots, reducing overall accuracy.

To solve these issues, we designed a custom 3D-printed concave flywheel whose profile closely matches the curvature of the game piece. This increased the contact area between the flywheel and the game piece, improving energy transfer while reducing unwanted slippage during launch.

Another challenge involved maintaining a constant flywheel speed during rapid firing sequences. Each launched game piece extracts energy from the flywheel, causing a temporary RPM drop. To minimize this effect, we embedded nine steel washers into the flywheel, increasing its mass to approximately 612 grams. The resulting increase in rotational inertia allowed the system to better resist speed fluctuations and maintain a more consistent exit velocity between shots.

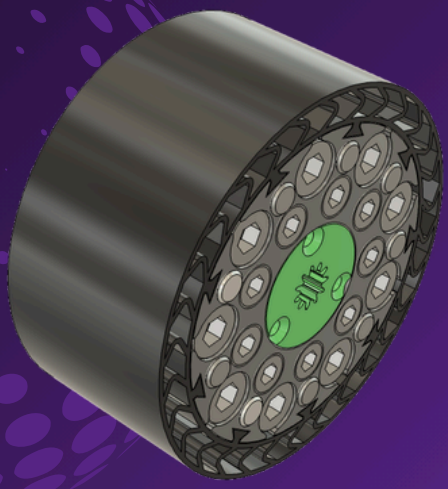




ROBOAS

#19082

FLYWHEELS

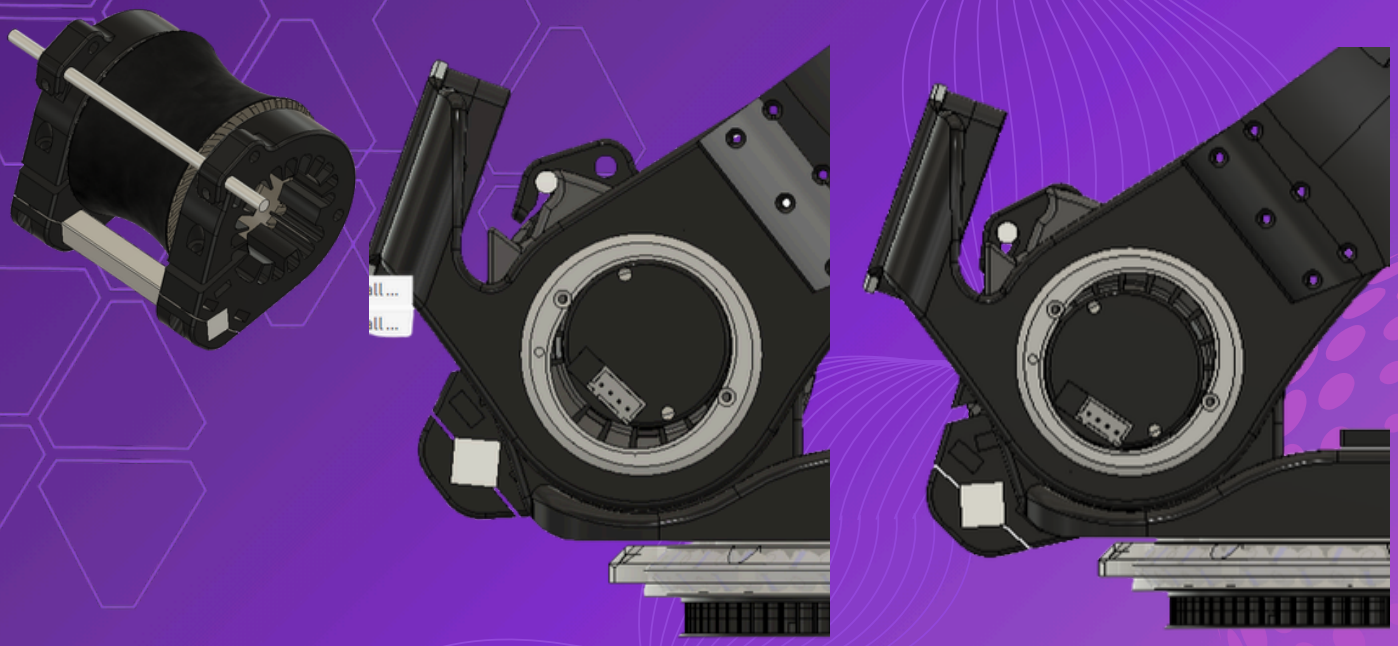


SHOOTERS

During testing, we also discovered that game pieces exhibited small manufacturing variations that affected compression inside the launcher. Rather than forcing every game piece into a fixed geometry, we developed a spring-loaded compliance mechanism. This system allows the flywheel assembly to move slightly when a game piece enters the shooter while maintaining a constant force through a calibrated spring. As a result, the launcher automatically compensates for dimensional differences and produces more consistent launches.

To further improve accuracy, the shooter operates using a velocity closed-loop control system. A feedforward model provides the majority of the required motor power while feedback corrections compensate for disturbances caused by launching game pieces. This allows the flywheel to recover to its target velocity rapidly after each shot.

The final shooter combines a weighted concave flywheel, adaptive compression system, integrated cooling solution, and closed-loop velocity control. Through multiple design iterations and extensive testing, we achieved a launcher capable of delivering fast, repeatable, and accurate scoring throughout an entire match.



ROBOAS #19082

THE HINGES

Many critical subsystems, including the shooter assembly, transfer system, sensors, belts, and wiring, are located within the center of the robot. On previous designs, accessing these components required the removal of multiple plates and fasteners, significantly increasing repair time and making troubleshooting more difficult.

To solve this issue, we designed a hinged top plate system. The upper structure of the robot, which supports the shooter and transfer assembly, is mounted on two rear hinges. By removing only a small number of easily accessible screws, the entire upper assembly can pivot upward, exposing the robot's internal mechanisms.

2025-2026 SEASON

8. PROGRAMMING

Innovation Design Creativity Impact Problem-solving STEM Build

RO_009

#19082 DECODE

I. DRIVER CONTROLLED PERIOD

SOFTWARE DESIGN APPROACH

During the driver-controlled period, the robot's software is optimized for a single driver. Using Command-based programming, we implemented multiple automation strategies to make the robot as easy to operate as possible. Additionally, we designed multiple controls for a more intuitive but also fool-proof operation.

CONTROLS FOR ENHANCED GAME STRATEGY ENGINEERING THE SHOT

In DECODE, offense and defence succeed each other quickly in a match. As such, in order to allow the driver to direct his focus to the agility of the robot instead of manually ensuring the scoring is reliable, we automated the shooting components to self-adjust based on the coordinates of the robot on the field.

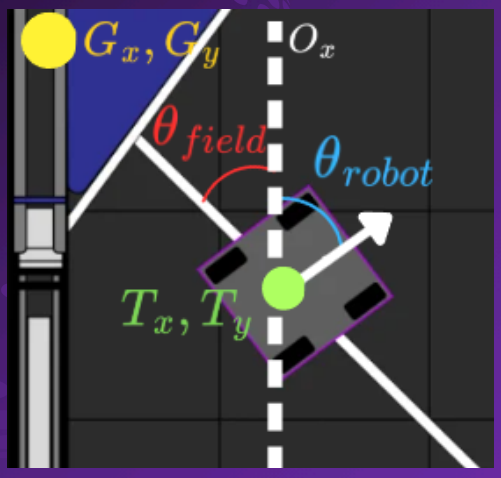
In the same manner of thought, we implemented an Intake automation that we will detail in the ***Automation*** section, but whose purpose is preventing the robot from intaking more than 3 artefacts at once. This is a Control Strategy meant to negate the risk of **G403/G404 penalties**, made possible by the robot's size. Additionally, when actively intaking, different LED coloration announces the state of the intaking action and notifies the driver when he should move to a launching zone.

1 THE HOOD

To automate launch geometry, our Adaptive Hood uses an **Interpolated Lookup Table** (InterpLUT) to map real-time Pinpoint odometry data to precise servo positions. By bridging robot coordinates and ballistic requirements, the software transforms the entire field into a viable scoring zone. This dynamic adjustment offloads complex kinematic calculations from the driver, ensuring a perfect flight path regardless of robot positioning and allowing for peak tactical focus during high-speed cycles.

2 THE TURRET

The Turret subsystem synthesizes field positioning and vision data to ensure the launcher remains physically locked onto the goal, regardless of chassis movement or orientation. Below is the explanation for the **main Aim Mode** of our turret, based on **Pinpoint** odometry.



For maximum precision, we transform Robot coordinates to Turret coordinates by decomposing the distance between their centers based on as follows:

$$T_x = R_x - distance \times cos(\theta_{robot})$$
$$T_y = R_y + distance \times sin(\theta_{robot})$$

This image demonstrates the automated coordinate transformation used to resolve the turret's target heading:

Field-Centric Goal Angle: The robot uses its Pinpoint odometry to calculate the angle between its current (Rx, Ry) coordinates and the goal's fixed position (Gx, Gy). This is determined using the inverse tangent of the coordinate delta: $\theta_{field} = \text{atan}\,2(G_y - R_y, G_x - R_x)$

Chassis Heading Correction: To determine the local turret angle, we must account for the Robot Heading θ_{robot} provided by the IMU.

The relative target angle is normalized to ensure the turret takes the shortest path: $\theta_{target} = \text{normalize}(\theta_{field} + \theta_{robot}) + \text{driverOffset}$

To maximize scoring speed and minimize mechanical wear, the turret never rotates more than 180° to reach a target. By applying Angle Normalization, the system continuously calculates the difference between the current orientation and the goal, snapping the target to the mathematically shortest route. It also ensures the target is always in range **[-90°, 360°]** required by mechanical constraints.

Once the turret's target angle is obtained, we use a PID + kS Controller for obtaining the desired movement. We will detail this in the ***Control Loops*** section.

3 THE FLYWHEEL

The Flywheel subsystem is engineered to deliver high-accuracy launches by maintaining precise rotational speeds regardless of the robot's position on the field. By combining a closed-loop control system with dynamic data mapping, we ensure every shot follows a predictable and repeatable trajectory.

While a standard physics-based projectile motion equation can estimate required exit velocity, we chose an Interpolated Lookup Table (InterpLUT) for our implementation, because it provides a near-instantaneous result through simple linear scaling and it allows us to modify specific distances that might be inconsistent due to field layout or carpet friction, without affecting the rest of the curve.

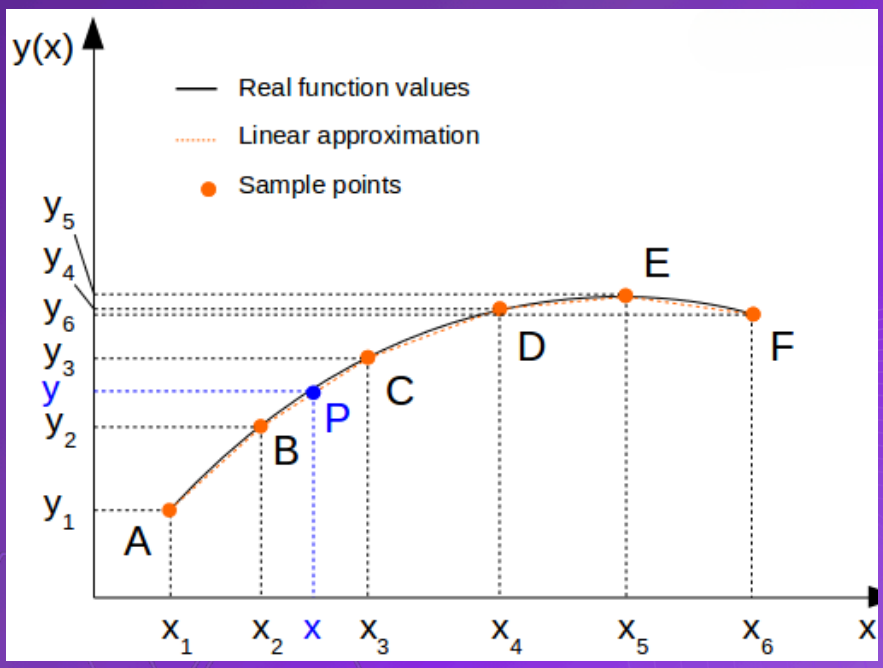


Diagram illustrating how InterpLUT works where X: distance and Y: velocity
Image Source: x-engineer.org

The InterpLUT calculates the target velocity V_{target} by finding the two closest pre-calibrated distance points (d1, d2) and their corresponding velocities (V1, V2):

$$V_{\text{target}} = V_1 + (d - d_1) \cdot \frac{V_2 - V_1}{d_2 - d_1}$$

Once the flywheel's target velocity is obtained, we use a Velocity-Closed-Loop model designed for rapid recovery to set the desired RPM. We will detail this in the ***Control Loops*** section.

4 SHOOT ON THE MOVE

SUMMARY & ENGINEERING TRADE-OFF

To achieve field-wide scoring consistency, our software architecture expands upon the baseline stationary kinematics above by applying **dynamic relative-frame transformations.** While our codebase successfully implements real-time vector compensation across all three shooting sub-assemblies (Turret Alignment, Flywheel Velocity, and Hood Trajectory Angle), empirical testing revealed a critical physical hardware limitation: the physical moment of inertia of our high-mass flywheel rotors prevented rapid, instantaneous velocity updates during high-acceleration chassis translations.

Consequently, to maximize system reliability and scoring cycle efficiency under match conditions, our team made a conscious design decision to electronically **deploy the Turret angular vector adjustments** while keeping the **Flywheel** and **Hood** systems bounded to optimized stationary lookup profiles. This section archives the complete multi-body kinematic calculations developed to prove the underlying mechanical physics of our design.

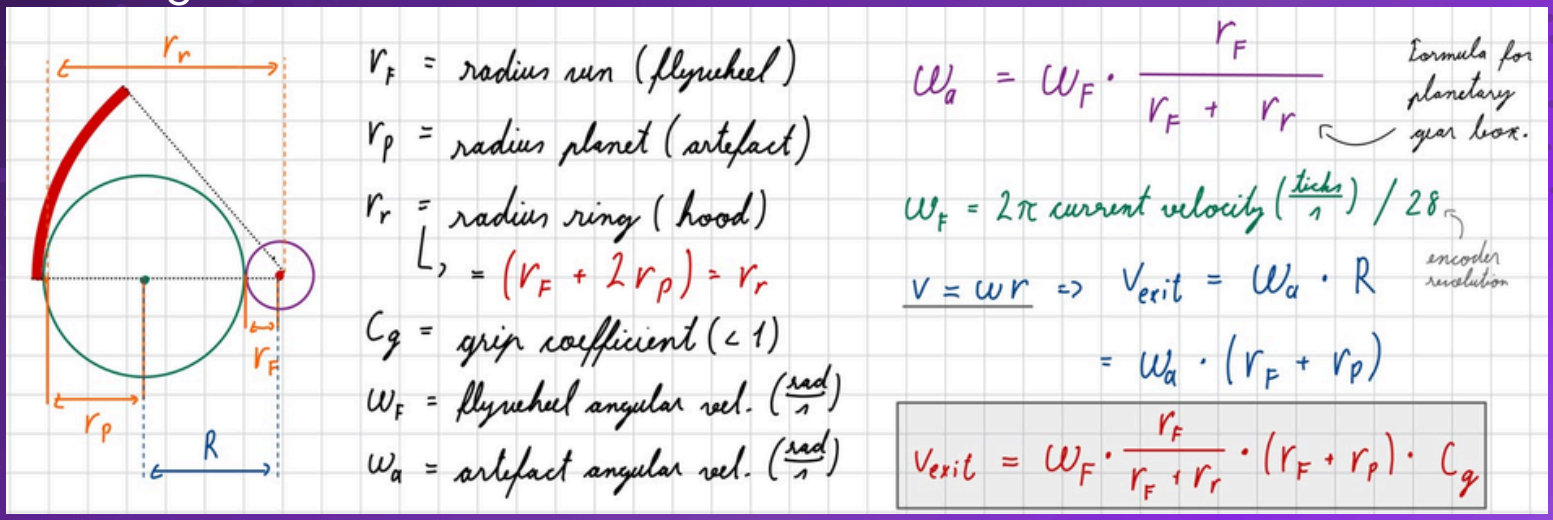
DYNAMIC VECTOR TRANSFORMATION MATH

When launching a projectile from a moving coordinate system, the vector trajectory observed from a stationary field orientation is a sum of the projectile's local exit velocity vector V_{launch} and the robot's immediate frame velocity V_{robot}: $V_{apparent} = V_{robot} + V_{launch}$

In an automated system, V_{robot} is actively provided by odometry sensors. However, to solve for the missing target orientation vectors, the software must know the magnitude of V_{launch} (defined as V_{exit}). Without an accurate real-time calculation of V_{exit}, the vector triangle cannot be closed because the system cannot determine how much the robot's inertia will warp the final trajectory.

4 SHOOT ON THE MOVE

Because our single-wheel launcher relies on a planetary epicyclic rolling effect, the true artifact velocity leaves the barrel faster or slower depending on transient battery voltage and motor spin-up states. By dynamically calculating V_{exit} inside our loop using raw encoder velocities (ω_F) and the physical boundaries of our planetary gear arm (r_F, r_p), we can compute an exact, non-approximated horizontal tracking frame.



Mathematic equations written before implementing Shoot On the Move

Step 1: Translating Relative Velocities via Projective Line-of-Sight

Using real-time local updates from our Pinpoint dead-wheel odometry computer, we extract the structural velocities along the global coordinate field vectors (v_x, v_y). We evaluate the geometric alignment delta ($\Delta\theta$) by comparing the current chassis trajectory angle against the line-of-sight vector pointing toward the target (G_x, G_y): $\theta_{velocity} = arctan(v_y / v_x)$ *and* $\Delta\theta = \theta_{velocity} - \theta_{field}$

We map the chassis speed into isolated orthogonal vector branches aligned relative to the target boundary position:

- **Radial Axis Component** (V_{rr}): Translates directly along the line of sight.
- **Tangential Axis Component** (V_{rt}): Translates perpendicular to the line of sight.

$$V_{magnitude} = \sqrt{v_x^2 + v_y^2}$$

$$\begin{cases} V_{rr} = -cos(\Delta\theta) \times V_{magnitude} \\ V_{rt} = sin(\Delta\theta) \times V_{magnitude} \end{cases}$$

Step 2: Dual-Axis Horizontal Frame Compensation

To ensure the target payload retains an uncorrupted transit time matching our look-up interpolation data baselines, the local propulsion mechanism must cancel out the perpendicular tangential inertia (V_{rt}) imparted by the moving chassis, while altering forward acceleration to compensate for compressed or expanded radial distances (V_{rr}).

1. **Compensated Linear Tracking Velocity** ($V_{x,compensated}$)

$$V_{x,compensated} = V_{exit} + V_{rr}$$

2. **Unified Transverse Component Magnitude** ($V_{x,new}$)

$$V_{x,new} = \sqrt{V_{x,compensated}^2 + V_{rt}^2}$$

Step 3: Deriving the Final Component Subsystem Adjustments

The angular offset ($\Delta\theta$) needed to counteract sideways chassis drift is resolved through a coordinate conversion mapping the tangential velocity against our modified tracking baselines:

$$\Delta\theta_{turret} = arctan(V_{rt}/V_{x,compensated})$$

Applying this modification to our local clockwise-positive turret framework yields the updated tracking equation deployed within our Turret subsystem automation routines:

$$\theta_{target} = \theta_{field} + \theta_{robot} - \Delta\theta_{turret}$$

To preserve perfect parabolic targeting across three dimensions when subjected to a shifting local origin, we calculate the unified launch magnitude by linking the updated horizontal vector with our static vertical profile ($V_y = v_0 \times sin(\alpha)$):

$$V_y = v_0 \times sin(\alpha)$$

$$\alpha_{new} = arctan(V_y/V_x, new)$$

$$V_{launch,new} = \sqrt{V_{x,new}^2 + V_y^2}$$

4 SHOOT ON THE MOVE

ENGINEERING RETROSPECTIVE: WHY WE BYPASSED FLYWHEEL AND HOOD SHOOT ON THE MOVE

While our software tracking models successfully simulated and calculated the exact vector speeds required to shoot accurately while moving, we encountered an insurmountable physical constraint during high-speed field testing: *Flywheel Rotational Inertia* (I) vs *Motor Torque Boundaries* (τ).

Why exactly does it fail?

1. Our single-wheel launcher contains substantial mass concentrated at its outer radius to maximize shot-to-shot velocity stability via mechanical energy storage ($E_k = \frac{1}{2}I\omega^2$).
2. When our drivetrain executes rapid maneuvers, the lookup vector demands sudden flywheel velocity changes (e.g., spooling up from 1700 RPM to 2150 RPM within a 120 ms path transition).
3. Because motor torque is bounded ($\tau = I\alpha$), our launcher, although precise and constant otherwise, could not match these intense acceleration profiles fast enough. This lag created transient velocity errors, causing shots fired mid-maneuver to consistently fall short or long of the goal.

By locking our launcher to a stabilized stationary distance lookup model and using driver offsets to smooth out transitions, our turret handles directional vector compensation instantly. This design ensures that the projectile trajectory stays locked on target while maintaining reliable vertical range consistency.

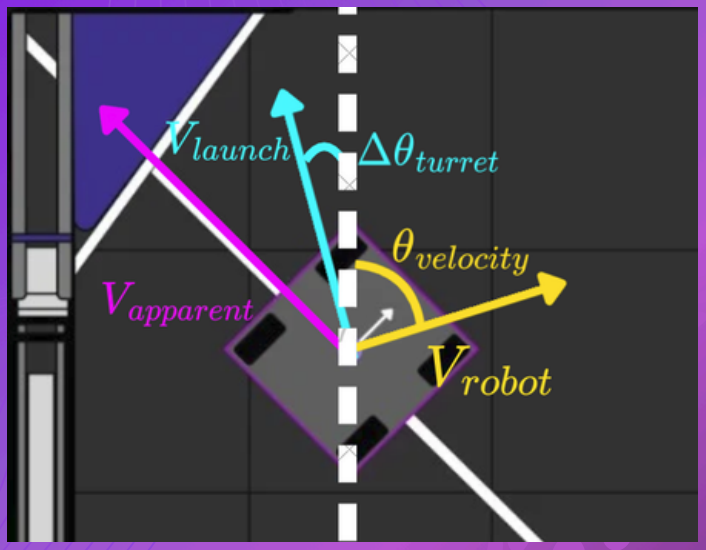
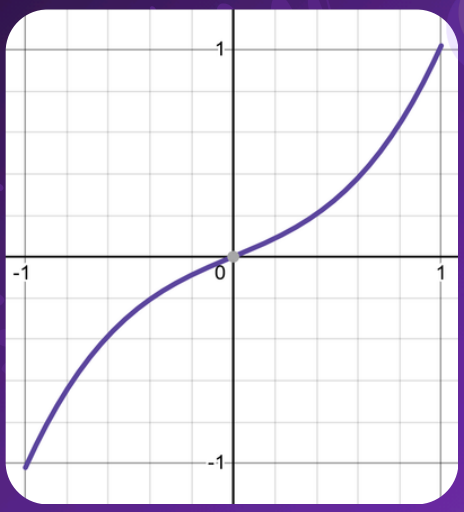


Diagram illustrating velocities we account for in the Shoot On The Move algorithm.

ROBOAS #19082

CONTROLS FOR ENHANCED ROBOT MOTION

To achieve smoother, more precise control of the Chassis mechanism, its speed is dynamically adjusted using the following cubic polynomial function:



$$f(x) = (x^3 + 0.7x) \times 0.6 \quad \text{where } x \text{ represents the joystick input}$$

Unlike a linear control approach, where motor power is directly proportional to joystick input, this function improves precision by creating a smoother transition between low and high speeds. Small joystick movements correspond to finer, more controlled adjustments, while higher speeds are only reached with more significant joystick input.

FAIL-SAFES

While the Intake, Turret and Sorter mechanisms are fully automated and typically require no manual control, fail-safe programs have been implemented in order to handle potential issues during matches.

- **Intake Fail-Safe:** If a scoring element gets stuck inside the Intake mechanisms or transfer at any point during the match, the driver can eject it instantly with a button press.

- **Turret Relocalization:** If large errors in targeting appear after autonomous to tele-op routine angle transfer or Pinpoint malfunction, driving the robot just above the gate (for near zone) or in the Observation Zone (for far zone) and pressing DPAD_UP or DPAD_DOWN respectively, will reset the Pinpoint and the targeting implicitly, recalibrating the turret for perfect aim.

- **Micro-adjustment for Turret:** In case the Pinpoint accumulates smaller errors, resulting in offset turret angles, the driver can increase or decrease the angle in increments of 2 degrees, for more accuracy and precision throughout the match.

- **Limelight Turret Aim:** If mechanical issues stop the turret from turning the full 450 degrees or the angle of the turret is offset too much to be corrected by the driver with the third fail-safe, instead of just resetting the turret using the second fail-safe, the driver also has a button that changes the aim mode from Pinpoint to Limelight, who detects the offset of the Fiducial IDs from the center of the Field Of View and then calculates the target angle, instead of relying on our own trigonometry.

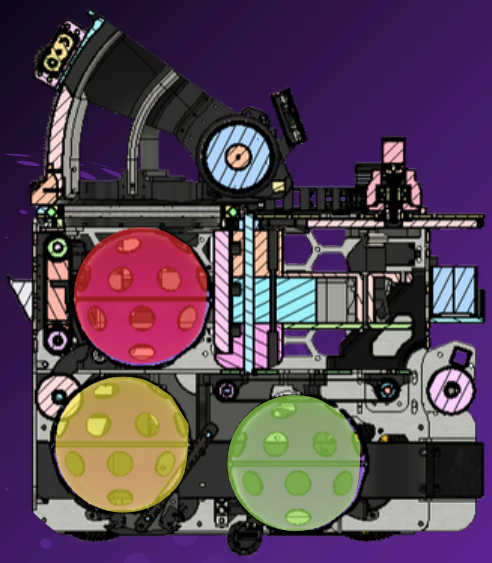
AUTOMATIONS

INTAKE AUTOMATION

Due to our robot size, in order to eliminate the risk of controlling more than three artefacts, we developed an autonomous monitoring system that overrides manual input when needed based on real-time sensor and limit switches reads. This automation is only used when intaking from the front of the robot because of the limit switches placement.

We use a triple sensor array to check if the three artefacts have reached the placement needed before launching, mapped across three primary zones:

- Zone 1 (Lower Entry): Limit switches below the horizontal belts detect the presence of the final artefact when intaking from the front.
- Zone 2 (Mid-Transition): Vertical limit switches verify when an element is properly seated on the pivoting pedal, and whether it was acquired from the front or back of the robot.
- Zone 3 (Upper Chamber): Proximity and color sensors detect the presence and hue of the highest-placed artefact before it reaches the launcher.



When the zone count reaches three (all artefacts are in place), the system automatically initiates a brief reverse sequence to account for intake inertia and eject any excess fourth artefact, and shuts down the intake motors. We preferred this solution over PID Control on the Intake in order to increase our loop times.

BACK INTAKE AUTOMATION

Due to the limited space at the back of the robot, we can fit only two artefacts. ***Before the sorter redesign,*** because our strategy relied heavily on using the back intake for human player cycling, when back acquisition wass detected, the system would automatically spin the sorter to make room for the third artefact, when prompted by the sensors. Using the same outtake button, the software monitored the sorter state and the artefacts' position. Once the transfer was cleared, the sorter's position would reset and throw the third artefact, only if previously acquired from the back of the robot.

SORTER AUTOMATION

Before the sorter redesign, the proximity and color sensors doubled in usage for the Sorter mechanism. The decision to sort happened after the Intake automation detected three artefacts, when the top artefact was surely well placed in the first slot of the Sorter.

The driver could activate and de-activate the Sorter on the touchpad. In order to maintain simplicity, the outtake button was overridden relying on the Command-Base architecture. As such, when the driver activated sorting, using the same button, the artefacts would be thrown in the correct order. The sorting algorithm counted the number of artefacts of each colour, remembering their current slot, and switched the slot based on the closest artefact of the desired color, if it existed.

ROBOAS #19082

COMMAND-BASED PROGRAMMING

Command-based programming is a modular and scalable design pattern that promotes reusability, maintainability, optimization, and—most importantly—automation. This approach structures robot control into subsystems (representing the robot's mechanisms), commands (which define actions), and command groups.

Each subsystem has dedicated commands that manage its states and actions.

Example: The Intake subsystem includes commands to toggle the state of the Intake itself and its servo, and activate its hardware components.

COMMAND GROUPS

Commands are combined into Command Groups, allowing the robot to execute multiple actions sequentially or in parallel based on driver or sensor inputs.

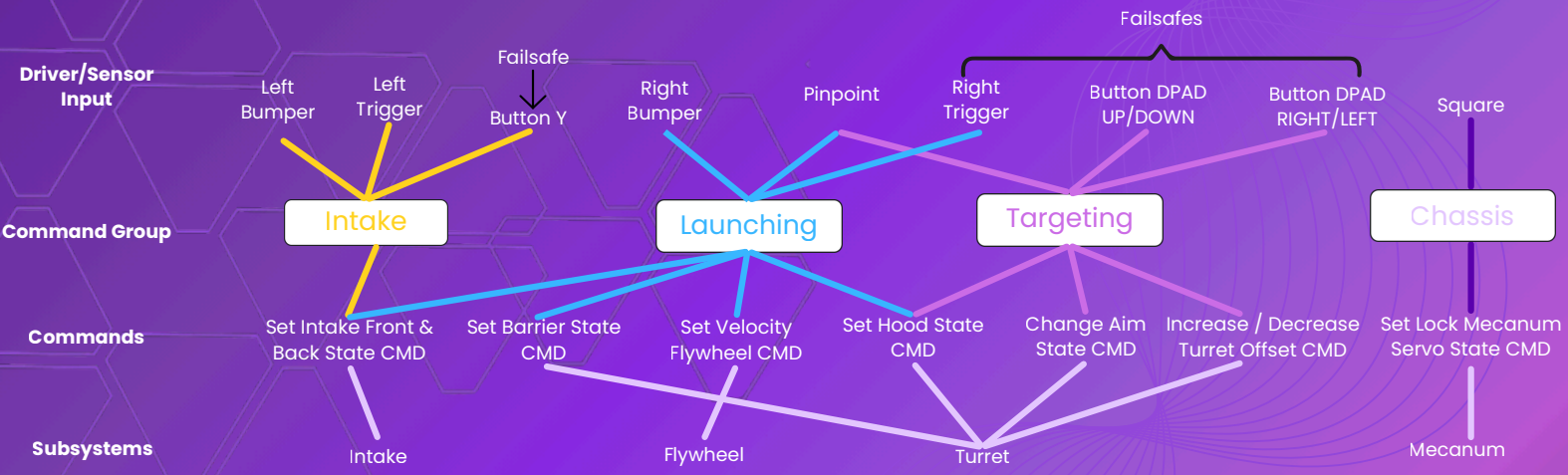


Diagram – Brief explanation of how we implemented Command-Based programming on our robot

ROBOAS #19082

SEQUENTIAL COMMAND GROUPS (FOR SMOOTH MECHANISM COORDINATION)

Some mechanisms require precise timing to function efficiently. By executing commands in sequence, we ensure smooth operation without interference.

Example: For the Intake automation, the Intake Servo will first lift, then we toggle the Intake Motor State twice before changing the LED colour, ensuring a smoother flow and no further delays than necessary.

PARALLEL COMMAND GROUPS (FOR TIME OPTIMIZATION)

Certain actions run simultaneously to maximize efficiency and reduce execution time.

Example: When the Outtake Command is triggered, the barrier and intake state will change simultaneously, powering the hardware on as soon as possible in order to launch the artefacts without delay.

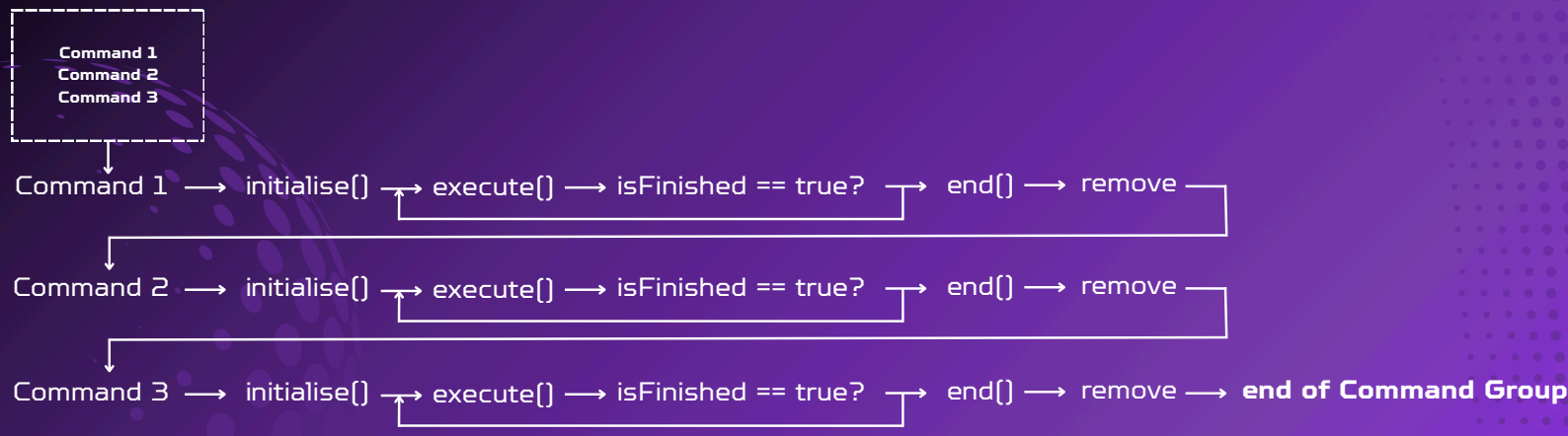
HOW ARE COMMAND GROUPS EXECUTED?

At the heart of command-based programming is the Command Scheduler, which manages the execution of commands. The scheduler operates in a continuous loop, handling the following tasks:

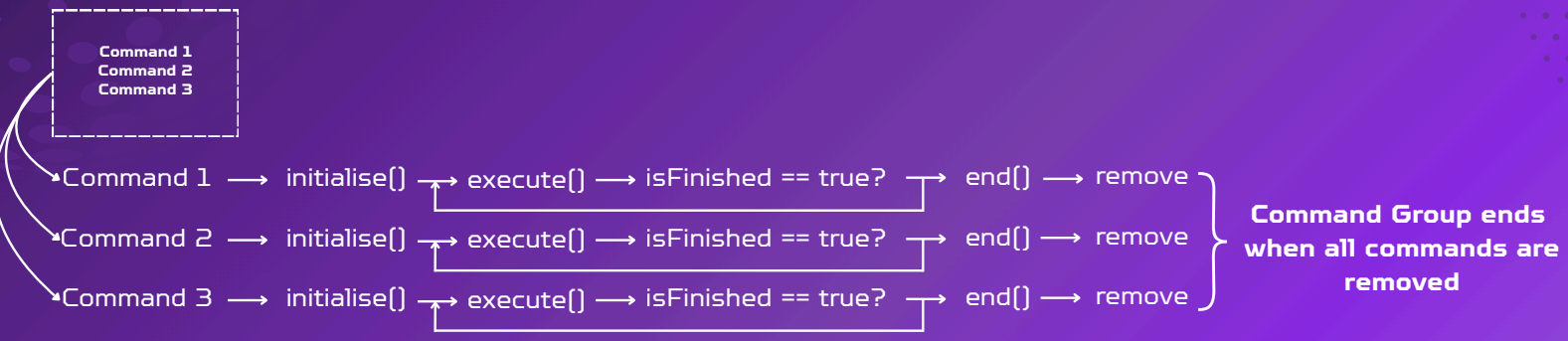
- **Scheduling Commands:** When a command is triggered (e.g., by a button press or an event), the scheduler adds it to the execution queue.
- **Executing Commands:** The scheduler runs active commands by repeatedly calling their **execute()** method.
- **Handling Command Completion:** When a command's **isFinished()** method returns true, the scheduler stops the command and removes it from the execution queue.

ROBOAS #19082

Sequential Command Group



Parallel Command Group



CONTROL SYSTEMS
PID CONTROLLERS

A PID Controller is a feedback control system used to achieve precise and stable control of a mechanism by continuously adjusting its output based on the error between the desired and actual position. We use them for the Turret and Flywheel subsystems.

How it works:

- Proportional (P) – Corrects based on current error.
- Integral (I) – Eliminates long-term errors.
- Derivative (D) – Prevents overshoot and oscillations.
-

The controller's output is calculated using the following formula:

$$Output = K_p \cdot Error + K_i \cdot \int Error + K_d \cdot \frac{d(Error)}{dt}$$

where: K_p, K_i, K_d are tuning constantsfor each term (P, I, and D)

ROBOAS #19082

FEEDFORWARD CONTROLLERS

While PID is a reactive control system (responding to error after it happens), a Feedforward controller is proactive. It uses a mathematical model of the mechanism to predict the amount of power required to achieve a specific set point, regardless of the current error.

How it works:

- Static Friction (kS): Provides the minimum burst of voltage needed to overcome the internal friction of the motor and gearbox to get the mechanism moving.
- Velocity Gain (kV): Provides a base power proportional to the desired speed. Since motors require more voltage to spin faster, kV ensures the motor has the necessary energy to maintain a target velocity.

The controller's output is calculated using the following formula:

$$Output = K_s \cdot \text{sgn}(v) + K_v \cdot v + K_a \cdot a$$

where: K_s, K_v, K_a are feedforward constants for each term (static friction, velocity, and acceleration)

WHY WE USE THEM

We chose to implement a combination of PID and Feedforward to handle the distinct physical demands of our Turret and Flywheel.

THE TURRET (PRECISION + STABILITY)

For the Turret, our primary goal is accuracy. Because the turret rotates a physical mass that must stop exactly at a specific angle (calculated via Limelight or Pinpoint), we rely heavily on PID.

We use a dynamic PID tuning strategy: our code adjusts kP, kI, and kD values based on the turret's current angle and the size of the error. This allows us to have aggressive values for large movements and gentler values for fine-tuning.

We added a kS (Static) feedforward term to ensure the turret doesn't "get stuck" due to friction when making the tiny degree adjustments needed for long-distance scoring.

THE FLYWHEEL (CONSISTENCY + RECOVERY)

For the Flywheel, velocity is the main component. If we relied solely on PID, the motors would only react after the wheel slowed down (like when a game element passes through).
Feedforward allows us to pre-load the motor with the exact voltage needed to reach a target RPM.
By using Feedforward to handle the heavy lifting of maintaining speed, the PID only has to handle minor environmental fluctuations. This results in much faster recovery times (aprox. 0.1 seconds) and highly consistent launch distances, which we manage through our Interpolated Look-Up Table (LUT).

II. AUTONOMOUS PERIOD

SOFTWARE DESIGN APPROACH

For our autonomous code, we evaluated whether to develop a custom pathing system or use an existing third-party library. Given our time constraints and the need for a highly performant and consistent autonomous program, we chose Pedro Pathing, a library developed by the mentor and alumni of FTC Team 10158 (Georgia, USA). This allowed us to focus on refining our autonomous strategy rather than building a pathing system from scratch. Additionally, we implemented fail-safes to handle field imperfections, human error, scoring elements blockages and time constraints.

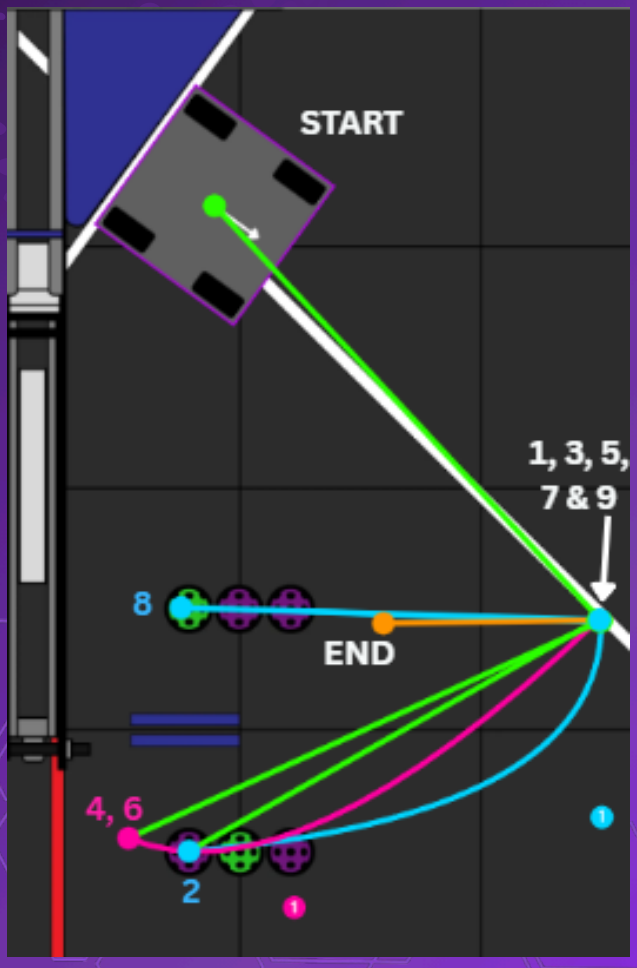
WHY PEDRO PATHING?

Pedro Pathing stood out due to its Bézier curve generation, which enables smoother, faster, and more efficient trajectories than traditional methods. Unlike many pathing libraries, such as Road Runner, which rely on purely kinematic models and spline-based trajectory planning, Pedro Pathing inherently optimizes for real-time corrections and fluid motion, making it a superior choice for our robot.

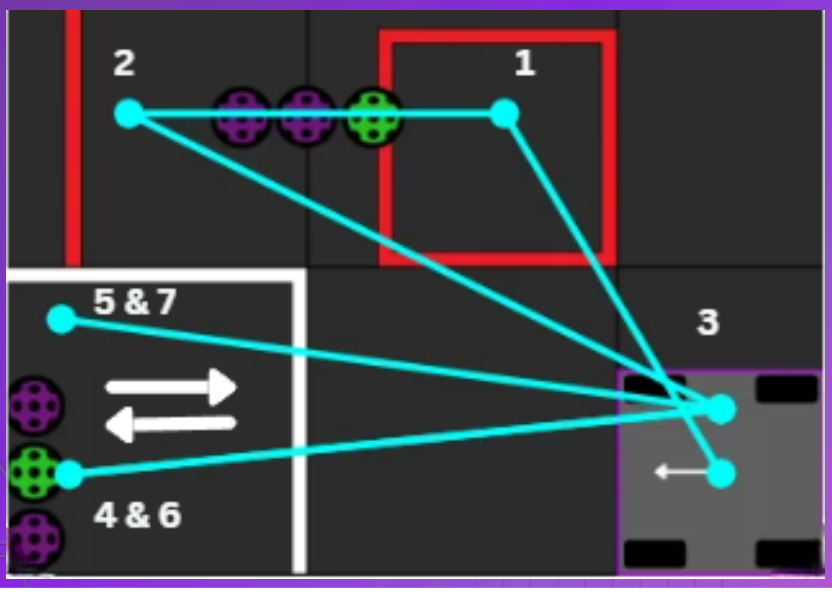
ROBOAS #19082

STRATEGY

Our strategy in order to match our autonomies with the highest number of alliances possible was to maximize the number of artefacts without interfering with our alliance's half of the field. As such, our autonomous routine from the near zone opens the gate 2 times, for both our own scoring and the alliance's.
After launching the preload and the two closest spikes of artefacts, we score 15 artefacts in total



However, from the far zone, since our flywheel and turret allow us to be precise and fast, we run four cycles after launching preload and a row of artefacts, thus scoring 9 artefacts without a gate opening, or 18 artefacts if our alliance opens the gate.



→ **paths to Outtake Point**

→ **paths for intaking rows of artefacts**

→ **paths for intaking from gate opening**

→ **path to Leave Point**

FAILSAFES

- **Trajectory skip:** If intaking a row of artefacts during autonomous routines takes more than 2.5 seconds because of robot blockages or field imperfections, the robot will correct from the current position to outtake, in order to continue the whole trajectory.
- **Automated Intaking Sequence:** In order to shorten intaking time as much as possible, we use the automation from Tele-Op. When we read limit switches and proximity/color sensors and all three return true values, the software will continue to the next path before reaching the exact hardcoded end of the trajectory, because we already have the necessary game elements.

III. PRETTY SMART SOFTWARE IMPROVEMENTS

This year, in order to compete at an international stage, our software had to go beyond basic functionality. We focused on improvements that solve common hardware limitations, such as communication latency and physical friction, ensuring the robot remains fast and precise under high-pressure match conditions.

1. HARDWARE BUS OPTIMIZATION - CACHING & THROTTLING

Communicating with the REV Hubs is the most significant source of loop latency. To maximize our cycle speed, we implemented Signal Throttling.

- **The Problem:** Standard code sends power updates to every motor every single loop, flooding the hardware bus with redundant data.
- **Our Solution:** We implemented a caching layer for our Turret and Chassis mechanisms. Before sending a command, the software checks: $|newPower - lastPower| > 0.005$

If the change is negligible, the command is suppressed. This clears the bus for critical sensors like the Pinpoint Odometry and Limelight, resulting in a more responsive robot.

2. MANUAL BULK READING MODE

Instead of querying sensors one by one, we configured our Hubs to Manual Bulk Read mode.

- At the start of every loop, the robot takes a single snapshot of all encoder positions and sensor states.
- Subsystems then pulls data from this local memory cache. This prevents the CPU from waiting on the hardware bus multiple times per loop, allowing our code to maintain a high frequency.

3. POSITION-BASED GAIN SCHEDULING

A unique challenge we faced was that the Turret's mechanical resistance changed depending on its rotation angle due to wire tension and weight distribution.

- **The Improvement:** Instead of one static PID, we developed Dynamic Gain Scheduling within a separate method.
- **How it Works:** The robot detects its current angle and the direction of movement (Clockwise vs. Counter-Clockwise). It then changes its *kP, kI, kD* and *kS* values in real-time. For example, moving toward 345° uses a much more aggressive kP (0.049) than moving toward 80° (0.018).
- This ensures the turret is equally snappy and precise across its entire 450◦ range of motion.

4. ADAPTIVE RESOURCE ALLOCATION

Processing color and proximity data is also computationally expensive. To keep our drive loop smooth, we implemented On-Demand Sensor Execution.

- Updating the LED status and keeping the artefact count only execute while the driver is actively holding the intake triggers.
- When the robot is in a traveling or shooting phase, these sensor checks are bypassed. This reallocation of CPU power ensures that maximum resources are dedicated to Turret Aiming and Drivetrain Precision.

By implementing these optimizations, we successfully increased our loop frequency from an average of 60Hz to over 100Hz, effectively doubling the intelligence of our control loops and making the robot significantly more stable and smooth on the field.