TEAM #24935

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ANTARES

ENGINEERING NOTEBOOK

ONE TEAM ONE DREAM

«SCIENCE IS ABOUT KNOWING; ENGINEERING IS ABOUT DOING.» — HENRY PETROSKI

DECODE 2025-2026

ENGINEERING NOTES

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ENGINEERING NOTES

TEAM INTRODUCTION

ABOUT US

Antares is a team of talented students from the Abai National School, one of Kazakhstan's leading schools. Since 2023, we have been building robots, solving challenges, and inspiring our peers. Antares is not just a team—it is a bright star of innovation and creativity, guiding future innovators.

OUR MISSION

Our mission is to develop robotics in the Kazakh language, introduce young people to science and technology, and expand STEM culture in Kazakhstan. Antares is a shining star opening the path to limitless possibilities for Kazakh youth.

INNOVATOR AWARD

FGC

ALMATY SCRIMMAGE

ALMATY REGIONAL

REACH AWARD WINNER

BISHKEK REGIONAL

WAY TO HOUSTON!

ENGINEERING NOTES

OUR SOCIALS

FROM STUDENTS – TO INNOVATORS

LEARN. BUILD. COMPETE. WIN.

- EXIST 3 YEARS
- START UP PROJECTS
- 400 OUTREACH HOURS
- MORE THAN A TEAM
- INNOVATION
- TEAM ANTHEM
- 900+ FOLLOWERS ON SOCIAL MEDIS
- MENTORS 2 TEAMS
- ONLINE AND OFFLINE SEMINARS 25+
- 3.500.000 TG FROM SPONSORS

YOUTUBE

INSTAGRAM

TIKTOK

TEAM MEMBERS

BALYM

"Everything that kills me make me alive"

CAPTAIN

"The person you become is your greatest achievement."

ENGINEER

DAULET

ERNAR

"Your future listens to what you do today."

CODER

TEAM MEMBERS

KARAKAT

"Life rewards those who move forward, even when the path is unclear."

HANDBOOK

"Not every step feels right, but every step forward matters."

DESIGNER

GULSIM

ALINUR

"Your effort decides how far you go."

CADER

TEAM MEMBERS

INKAR

SMM

"Success begins with how you think, not what you have."

MANAGER

"Your choices today shape your future tomorrow."

AYAZHAN

KARAKAT

SPEAKER

"Success is built quietly, long before it is noticed."

TEAM MEMBERS

TURAN

"Good movement with the mind — a path to success in life."

BUILDER

"Dicipline turns potential into results."

ANALYTIC

MEIRLAN

BALNUR

"A clear mind builds strong systems."

INSPIRE

TEAM MEMBERS

ABISH

DRIVER

"Small improvements create big change."

MENTOR

"Think precisely. Build confidently."

AKMARAL

AIZHAN

MENTOR

"Logic is the foundation of creativity."

CORE VALUES OF FIRST

CONNECT

IN OUR LABORATORY, FIVE TEAMS ARE PREPARING AT THE SAME TIME, INCLUDING OUR OWN: ESPADA, SUNRISE, WATER7, AND KHAN. WORKING TOGETHER GIVES US REAL ADVANTAGES, WHICH CAN BE EXPLAINED BY THE FOLLOWING POINTS.

FIRST, ENGINEERING EFFICIENCY.

DURING PREPARATION, WE DESIGN, BUILD, AND TEST ROBOTS. JOINT TESTING HELPS US IDENTIFY MECHANICAL AND SOFTWARE ISSUES FASTER, COMPARE DIFFERENT ENGINEERING SOLUTIONS, AND CHOOSE THE MOST EFFECTIVE MECHANISMS.

SECOND, KNOWLEDGE SHARING.

EACH TEAM HAS ITS OWN APPROACH TO DESIGN, PROGRAMMING, AND STRATEGY. BY SHARING EXPERIENCE, WE ACCELERATE LEARNING AND RAISE THE OVERALL ENGINEERING LEVEL OF ALL PARTICIPANTS.

THIRD, TEAM SUPPORT AND RELIABILITY.

WORKING IN A SHARED LABORATORY CREATES A CULTURE OF MUTUAL SUPPORT. TEAMS HELP EACH OTHER WITH ASSEMBLY, DEBUGGING, AND IMPROVING ROBOTS, WHICH REDUCES RISKS BEFORE COMPETITIONS AND MAKES PREPARATION MORE STABLE.

FOURTH, UNDERSTANDING THE TRUE MEANING OF ROBOTICS.

FORCE SHOWS US THAT ROBOTICS IS NOT JUST ABOUT COMPETITION, BUT AN ENGINEERING PROCESS THAT REQUIRES ANALYSIS, TESTING, TEAMWORK, AND CONTINUOUS IMPROVEMENT.

POWERFULL 34001 FTC

ESPADA

STRONG TEAMS, ENGINEERING THINKING, AND COLLABORATION ARE THE KEY FACTORS FOR SUCCESS IN ROBOTICS, AND THE ROBOT ITSELF IS THE RESULT OF THIS COLLECTIVE EFFORT.

NEW YEAR SCRIMMAGE

ESPADA × ANTARES × SUNRISE

HOW DID WE ORGANIZE THE SCRIMMAGE?

The NEW YEAR SCRIMMAGE was organized in collaboration with the Sunrise and Espada teams, with a shared goal of creating not only a competitive event, but also a space for teamwork, connection, and inspiration among participants.

Responsibilities were clearly divided, ensuring smooth teamwork and a successful event.

SPECIAL ATTENTION TO PARTICIPANTS

Every participant, guest, and mentor received specially prepared custom stickers and traditional Kazakh sweets. This gesture reflected our gratitude, hospitality, and desire to promote national values.

In addition, the venue was tastefully decorated in a New Year style, creating a festive and motivating atmosphere. The decorations lifted everyone's spirits and enhanced the overall impression of the event.

NEW YEAR SCRIMMAGE

PARTICIPATING TEAMS

More than 10 teams took part in the scrimmage, showcasing their knowledge, creativity, and teamwork.
Throughout the competition, a true sense of rivalry blended with a friendly and supportive spirit:

1.KAP
2.Irys
3.Uly Dala
4.Bil Barbie
5.Neura
6.Sirius
7.Axis
8.Setap
9.Horizon
10.SANA
11.Thunder Bolts

PRIZE POOL

The prize fund provided strong motivation and emphasized the importance of the competition:

- Winning Alliance Captain — 50,000 KZT
- Winning Alliance Partner — 25,000 KZT
- Finalist Alliance Captain — 15,000 KZT
- Finalist Alliance Partner — 10,000 KZT

THE WINNERS

- Winning Alliance Captain — SANA
- Winning Alliance Partner — KAP
- Finalist Alliance Captain — Neura
- Finalist Alliance Partner — Thunder Bolts

Best New Year Dress Code — Sirius
Additionally, special nominations were awarded to individual participants who stood out by fully embracing the New Year style.

NEW YEAR SCRIMMAGE

CHALLENGES AND SOLUTIONS

CHALLENGE	DESCRIPTION	SOLUTION
1.	Limited time for organizing the event	Teamwork and planning ensured all tasks were completed on time.
2.	Lack of sponsors	Team unity allowed all expenses to be covered internally.
3.	Difficulty finding referees	Teams cooperated to resolve the issue and ensured fair competition.
4.	Scheduling conflicts	A mutually convenient time was chosen for all teams.
5.	Venue and technical preparation	Tasks were divided; each team managed technical responsibilities.
6.	Information not reaching all teams on time	Shared channels ensured timely information for everyone.

NEW YEAR SCRIMMAGE

THE NEW YEAR SCRIMMAGE WAS MORE THAN JUST A COMPETITION; IT SERVED AS A PLATFORM FOR NEW EXPERIENCES, TEAMWORK, AND COLLABORATION. THROUGHOUT THE EVENT, PARTICIPANTS HAD THE OPPORTUNITY TO SHOWCASE THEIR CREATIVITY, BUILD NEW CONNECTIONS, AND DEVELOP THEIR SKILLS.

THE SCRIMMAGE ACTED AS A MOTIVATIONAL SPACE FOR ALL TEAMS.

EACH TEAM AND PARTICIPANT TESTED THEIR ABILITIES AND GAINED EXPERIENCE IN A FAIR AND COMPETITIVE ENVIRONMENT.

ORGANIZATIONAL CHALLENGES (LIMITED TIME, LACK OF SPONSORS, TECHNICAL ISSUES) WERE SUCCESSFULLY OVERCOME THROUGH TEAMWORK AND MUTUAL SUPPORT.

PARTICIPANTS GAINED VALUABLE ORGANIZATIONAL SKILLS AND STRENGTHENED TRUST.

OVERALL, THE NEW YEAR SCRIMMAGE FOSTERED A CREATIVE ATMOSPHERE, UNITY, AND MOTIVATION. THIS EXPERIENCE MARKS AN IMPORTANT STEP TOWARD LARGER, MORE MEANINGFUL, AND IMPACTFUL PROJECTS IN THE FUTURE.

ANTARES OFFICIAL WEBSITE

ABOUT THE ANTARES TEAM WEBSITE

The Antares team has developed an official website to systematize the team's activities, present information on a single platform, and provide users with an accessible digital resource.

The website has been created according to modern web development standards, featuring a logical structure and user-friendly navigation. The clarity and accessibility of information were the primary priorities.

The main objectives of the website are:

- To provide clear and organized information about the team's activities;
- To showcase achievements and projects on a single platform;
- To offer educational resources and facilitate experience sharing.

The website provides detailed information about the team members:

- **Mentors** (2 persons) — provide guidance and technical and organizational support.
- **Captain** — leads the team and organizes projects.
- **Participants** — work in engineering, programming, and media departments; develop projects and prepare for competitions.

Each member's role within the team is clearly indicated, which helps to understand the internal structure and individual responsibilities.

ANTARES OFFICIAL WEBSITE

OBJECTIVES

THE ANTARES WEBSITE IS AIMED AT ACHIEVING THE FOLLOWING OBJECTIVES:

To systematize and publicize the team's activities.

To present the team's achievements, awards, and experience in a centralized manner.

To facilitate experience sharing through educational materials and practical guides

To provide informational resources for students and beginners interested in robotics.

To provide users with a visually and functionally convenient digital platform.

Technical Info / About the Website:

- Developed using modern web technologies with a focus on responsive design.
- Prioritizes usability, accessibility, and visual appeal.

Learning Materials:

- PDF guides, coding examples, and schematic diagrams. Robotics tips & tricks to support beginners and enthusiasts.

Contact / Feedback:

- E-mail, social media links, and a contact form for questions or suggestions.

ANTARES OFFICIAL WEBSITE

«QADAM» JOURNAL

THE «QADAM» JOURNAL IS ONE OF THE MAIN INFORMATIONAL SECTIONS OF THE WEBSITE. IT DISPLAYS THE TEAM'S WORKFLOW, EXPERIENCE, AND PRACTICAL MATERIALS.

FLL / FTC BEGINNER'S GUIDE

- Provides practical steps and instructions for newcomers.
- Explains the process of designing, programming, and preparing robots for competitions.

TIPS

- Competition preparation strategies.
- Effective team communication.
- Time management and handling mistakes.

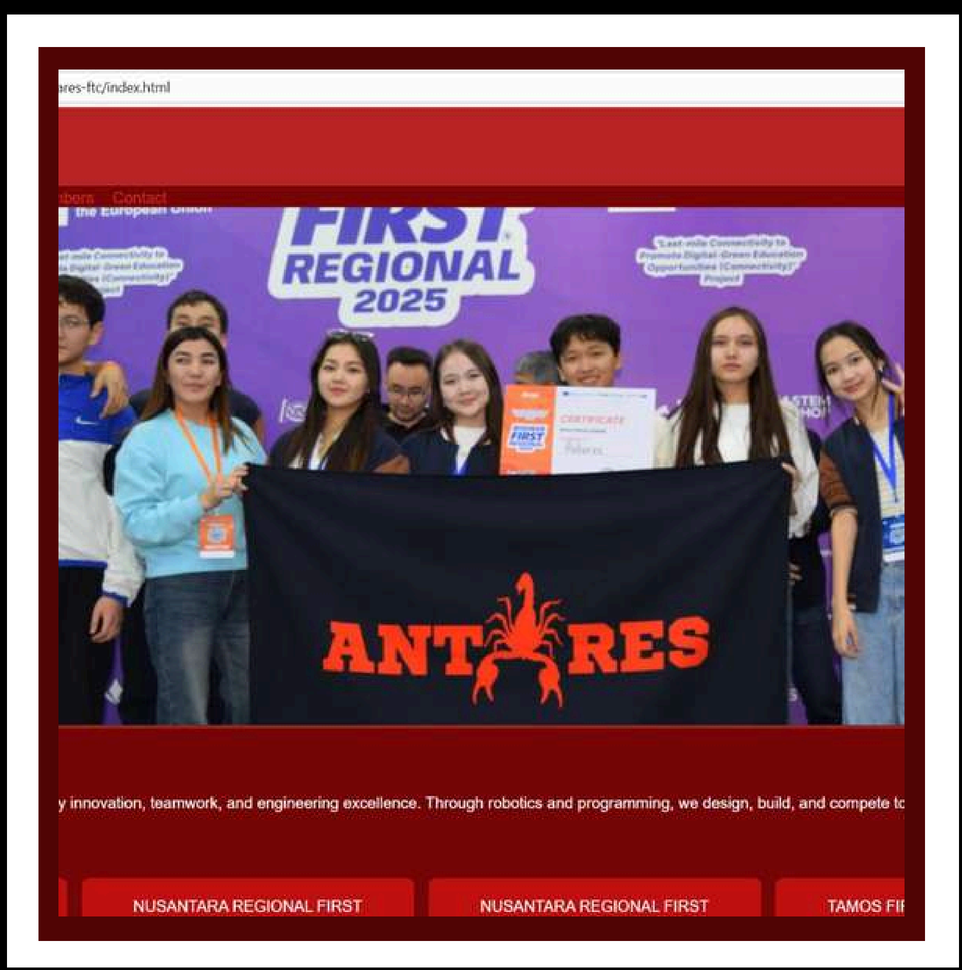
TUTORIAL VIDEOS

Tutorial videos for the website are recorded. The videos demonstrate how to use the site sections, key steps in robotics, and team work. Videos allow students to quickly understand the material and apply it in practice.

ANTARES
OFFICIAL WEBSITE

AWARDS

This section officially presents the achievements of the Antares team:



- **Awards and certificates received in competitions.**
- **Team and individual accomplishments.**
- **The awards officially recognize the team's professional growth and efforts.**

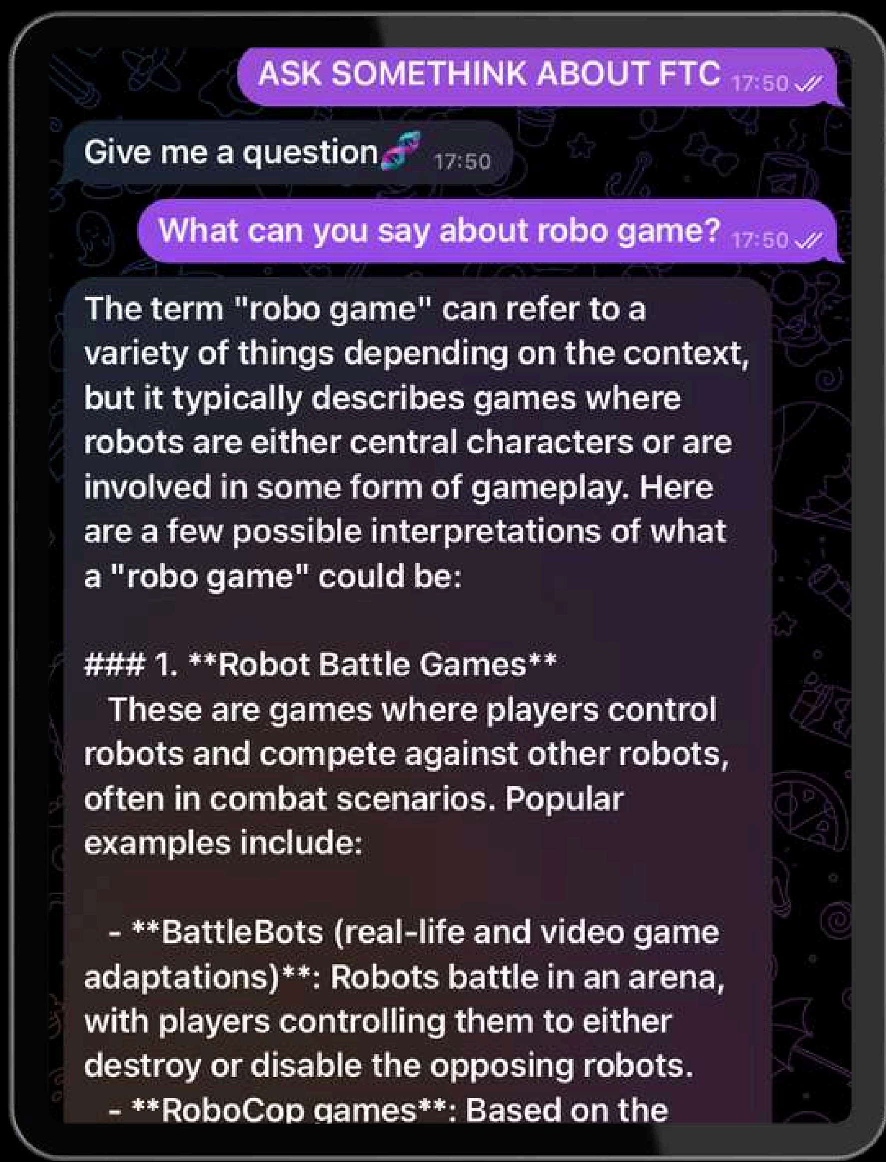
NUSANTARA REGIONAL FIRST CHAMPIONSHIP FINALIST ALLIANCE CAPTAIN
NUSANTARA REGIONAL FIRST CHAMPIONSHIP THINK AWARD WINNER
NUSANTARA REGIONAL FIRST CHAMPIONSHIP CONTROL AWARD 3RD PLACE
TAMOS FIRST CHAMPIONSHIP CONTROL AWARD WINNER
FIRST TECH CHALLENGE CENTRAL ASIA THINK AWARD 3RD PLACE
FIRST TECH CHALLENGE CENTRAL ASIA PROMOTE AWARD 3RD PLACE
FIRST TECH CHALLENGE CENTRAL ASIA DESIGN AWARD WINNER
ALMATY REGIONAL FIRST CHAMPIONSHIP THINK AWARD 2ND PLACE
ALMATY TECH CUP CONTROL AWARD 2ND PLACE
TAMOS OFF-SEASON FIRST CHAMPIONSHIP INNOVATE AWARD WINNER
ZHYLANDY REGIONAL FIRST CHAMPIONSHIP DESIGN AWARD WINNER
FIRST. GLOBAL CHALLENGE 2025 KAZAKHSTAN INNOVATOR 3RD PLACE
BISHKEK REGIONAL FIRST CHAMPIONSHIP REACH AWARD 2025

In the future, the website will continue to expand, incorporating new learning materials, video tutorials, project updates, and interactive features to further support the growth and development of the robotics community.

TELEGRAMM BOT

ENGINEERING AND SCIENTIFIC DESCRIPTION OF AN AI-BASED TELEGRAM BOT

The bot's functional structure consists of three main modules.



The first is an interactive dialogue system that uses Natural Language Processing (NLP) to analyze user queries and provide technical responses related to FIRST, STEM, and robot programming, including guidance on correcting algorithmic, logical, and syntactic errors.

The second module is an informational database containing structured data about the team, engineering projects, awards, and achievements, organized according to engineering documentation principles.

The third module is a FIRST resource system that offers methodological and technical materials for robot design,programming, and competition preparation.

Overall, the project demonstrates the integration of software engineering, artificial intelligence, and robotics, contributing to the development of engineering thinking, algorithmic skills, and practical experience.

FTC NEWS INDONESIA

The development of engineering relies on practical experience, effective information sharing, and collaboration. Within the FIRST Tech Challenge (FTC) program, FTC News Indonesia contributes by systematically providing engineering-related information.

The FTC News Indonesia channel provides information on FTC teams, their robotic projects, and applied engineering solutions, including robot designs, control algorithms, and technical results, supporting practical learning and understanding of engineering project structures.

Skill Development and International Experience

FTC News Indonesia demonstrates practical engineering skills such as mechanism design, programming, sensor integration, and teamwork, helping learners master analysis, design, and testing. The channel also connects teams with the international FTC community, sharing competition standards and best practices.

Motivation and Career Impact

By publishing competition results and achievements, the channel increases students' interest in engineering, boosting participation in STEM fields and engagement in projects.

Conclusion

FTC News Indonesia serves as a key informational platform, supporting practical skill development, promoting international standards, and enhancing motivation, thereby contributing significantly to the advancement of engineering.

NEWS FTC INDONESIA IS REPRESENTED BY
ANTARES #24935
RHINOBOT #26488

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CHECK OUT @news.ftc.id

TEAM BATTLE

We have developed a new project called Team Battle. The project is designed for two teams to share their ideas on a specific topic. This is not a traditional competition but a process of discussing engineering challenges, exchanging experiences, and exploring new solutions.

INITIAL PARTICIPANTS

Our first guest team was Espada. During the discussions, various engineering topics were addressed, including:

- Methods to implement autonomous functions in robots — selecting fast and efficient algorithms, processing sensor data;
- Ways to improve energy efficiency — extending battery life, optimizing robot movement;
- Integration of robot sensors and control systems — enhancing control efficiency through proper sensor data processing;
- Improving team work models — distributing roles effectively and improving communication;
- Rapid prototyping and testing of projects — experimentally building and evaluating robot designs.

DISCUSSION SIGNIFICANCE

Teams shared their experiences and scientifically grounded suggestions, generating new ideas, innovative approaches, and practical solutions. These discussions allow other students and members of the engineering community to gain inspiration, apply practical solutions, and develop real engineering projects.

MAIN OBJECTIVE

The main objective of the Team Battle project is to encourage teams to develop engineering thinking, generate new solutions and innovative ideas, and enhance practical engineering skills through experience sharing. Through discussions, participants learn to analyze engineering problems and find solutions, thereby deepening their knowledge in STEM and robotics.

FAIL CONFERENCE

KURALAY BAITAZHIKOVA

She is:

- Organizer of the “Fail Conf” Ped-Hackathon
- Mentor of the @auylpedacademy project
- Head of @ustart.academy

Kuralay launched a new format, the Fail Conference, created specifically for teachers. Its mission is to foster a culture where educators feel safe to share their mistakes and learn from them.

FROM TEACHERS TO ROBOTICS

Originally, this project was created as a platform for teachers to openly share their mistakes and learn from each other. Its effectiveness in education quickly became evident.

As the Antares team, we adapted Kuralay’s idea to the world of robotics.

Why is the Fail Conference important in robotics?

Mistakes are inevitable in robotics — from broken motors and malfunctioning code to unresponsive sensors. The Fail Conference helps us to:

- Overcome the fear of making mistakes
- Learn from other teams’ experiences
- Strengthen team trust
- Generate new engineering idea
- Build technical thinking and resilience

Every failure is a new opportunity.

PODCAST TIME

"Podcast Time" is our original project, and several episodes have been produced to date. The first podcast was conducted with the team leader, **Akmaral Akylzhankyzy**, and the next episode featured an interview with the **"Uly Dala"** team.

Scientific and Educational Objectives of the Project:

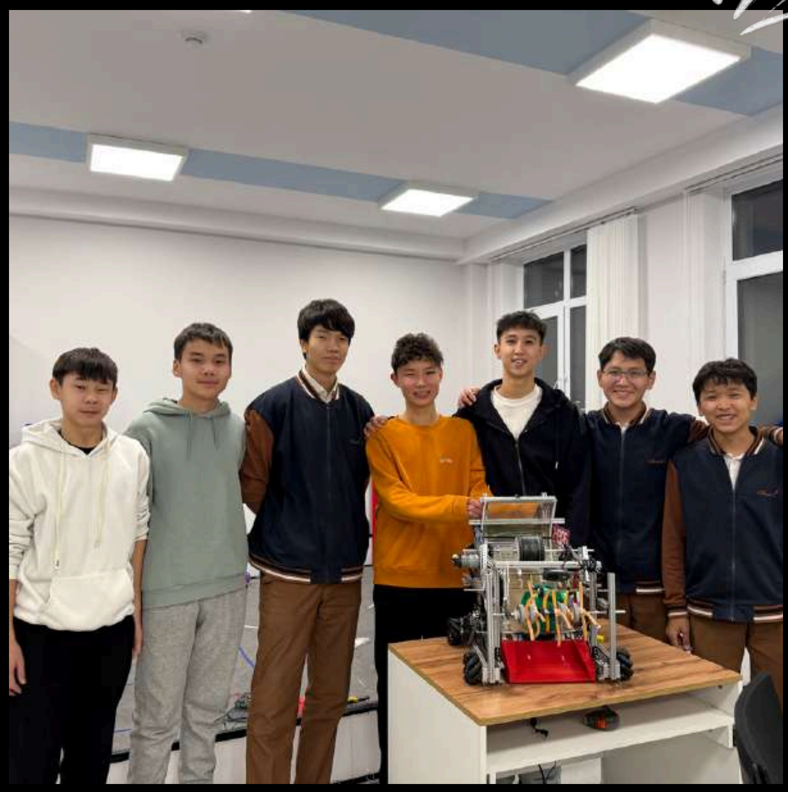
DEVELOPMENT OF ROBOTICS EDUCATION IN THE KAZAKH LANGUAGE:

Promoting the use of Kazakh-language technical terminology and supporting the integration of robotics into the national educational space.

ENHANCEMENT OF ENGINEERING THINKING AND TECHNICAL CULTURE:

Creating a platform for experience sharing among teams to analyze programming challenges, technical errors, and engineering solutions, fostering problem-solving skills, innovation, and learning through mistakes.

Engineering and Practical Aspect:
The podcasts focus on discussing robot code, programming challenges, and technical failures, promoting collaborative problem-solving and the development of engineering thinking.



Core Scientific Idea:
The project advances engineering practice by learning from mistakes and integrating theory with real-world robotics experience.

Robotics Introductory Course (Grades 7–8)

Target audience:

7–8 grade students who joined the robotics program in the current academic year and have no prior experience.

Course duration:

1 week (6 instructional days)

COURSE STRUCTURE

Day 1–2: Introduction to Robotics

- What robotics is and where it is used
- Basics of robot control and movement
- Overview of robotics competitions
- Introduction to the FIRST program and its core values

Day 5–6: Practical Application

- Hands-on robot control
- Applying programmed commands to real robots
- Testing, debugging, and improving robot behavior
- Team-based practice activities

Day 3–4: Programming Fundamentals

- Introduction to robot programming
- Software and applications used for programming
- Basic programming logic and commands
- Understanding what is essential and valuable in FIRST (teamwork, innovation, problem-solving)

Final Day: Selection and Team Formation

- Practical assessment of students' skills and engagement
- Selection of students with strong interest and demonstrated ability
- Formation of a focused group for advanced training
- Planning the launch of a new robotics team

COURSE OUTCOME

By the end of the course, students gain foundational knowledge of robotics and programming, practical experience in robot control, and an understanding of FIRST values. The course also serves as a selection pathway for forming a competitive robotics team.

Promoting Robotics Education Through Social Media Engagement

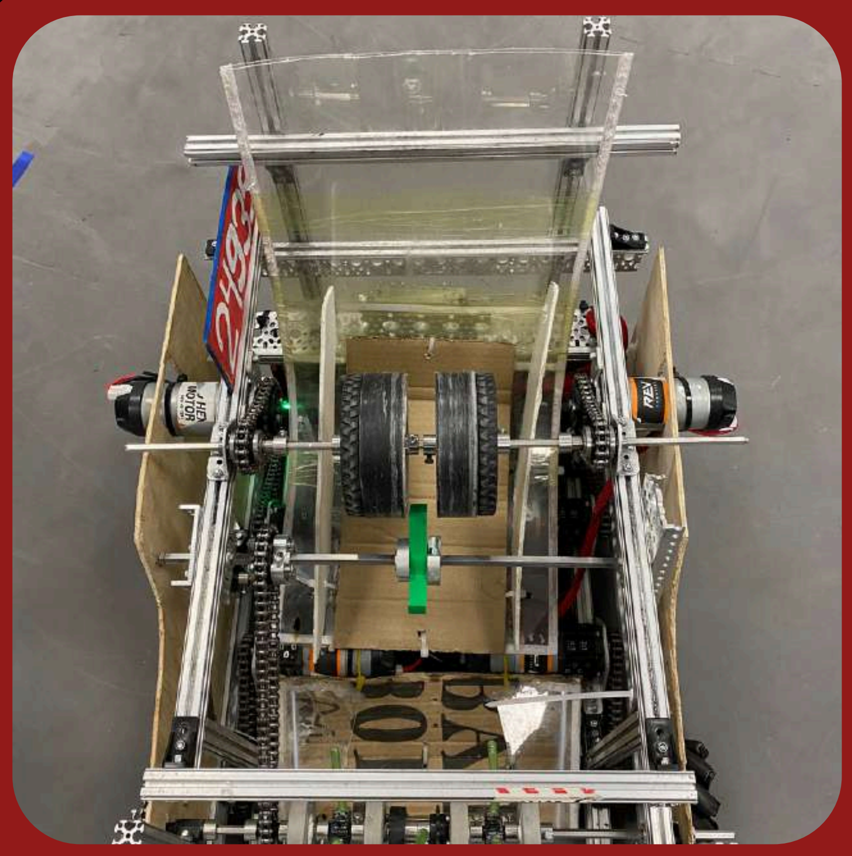
The main objective of the giveaway was to attract attention to robotics and engineering, as well as to motivate students to explore technical disciplines independently.

As part of promoting engineering education and increasing interest in robotics, we organized an interactive giveaway on the official Antares Instagram page. The format was inspired by widely used engagement practices on platforms such as Instagram and TikTok.

Winners were selected using a random chat-roulette tool, ensuring transparency and fairness in the selection process. The prizes consisted of robotics-related books, designed to help participants expand their engineering knowledge and develop technical thinking.

This initiative not only increased audience engagement but also contributed to the promotion of engineering and robotics education by providing valuable learning resources to a wider community.

ROBOT EVOLUTION



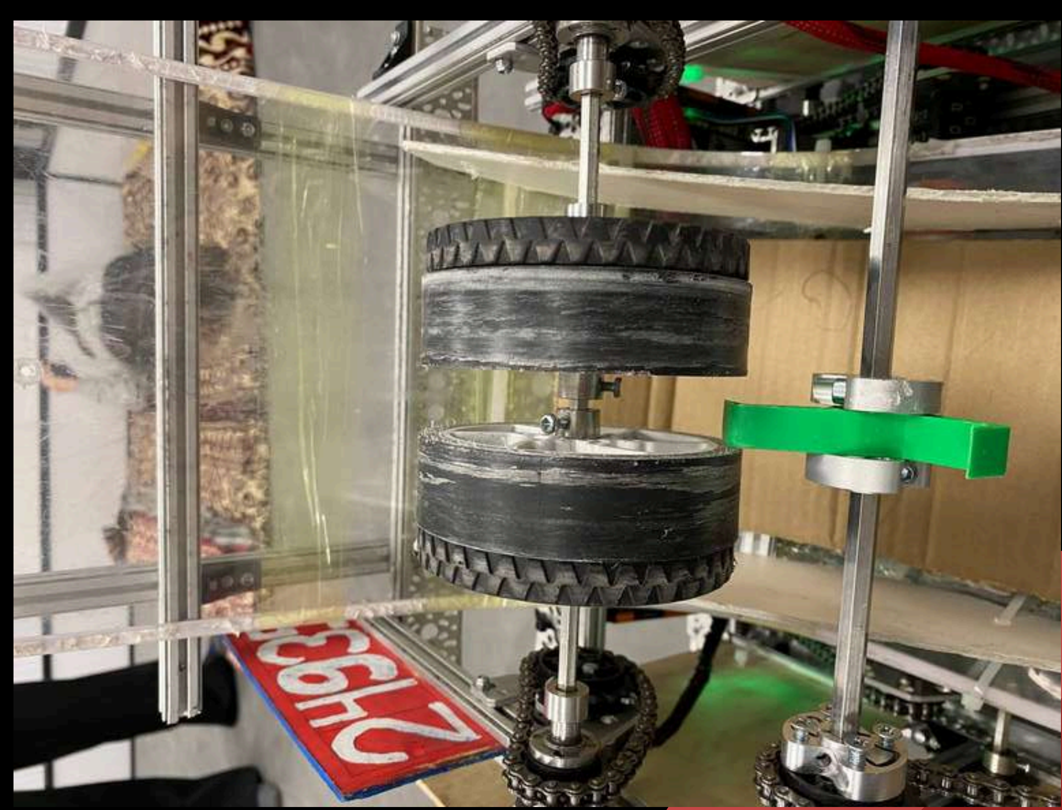
VERSION 1

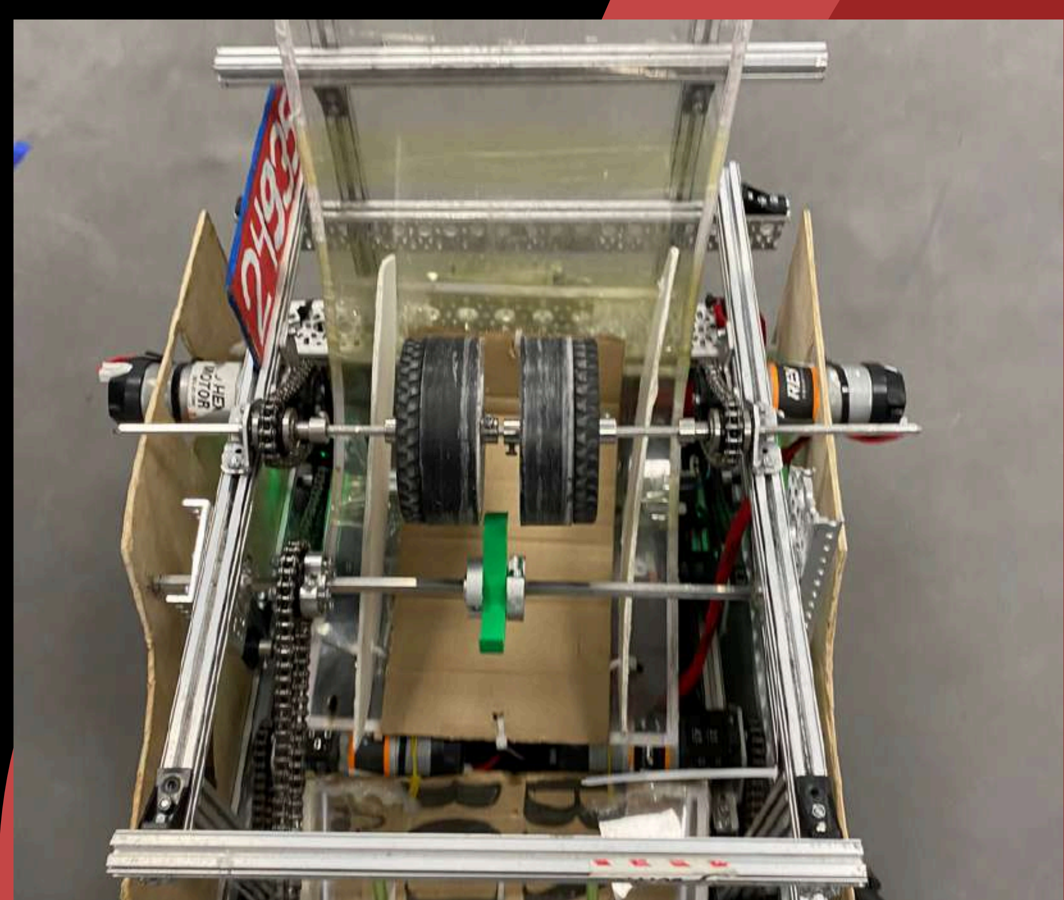
Below is a technical, innovative, engineering-notebook–style English version of the Robot Version 1 full review, written the way a FIRST engineering notebook is expected to sound: clear, structured, analytical, and professional.

ROBOT VERSION 1 – ENGINEERING OVERVIEW

GENERAL DESCRIPTION

The first version of the robot was developed as an initial functional prototype to test artifact collection and scoring through a shooter mechanism. The main goal of this version was to maximize artifact collection speed and ensure reliable transfer of artifacts into the shooter system.





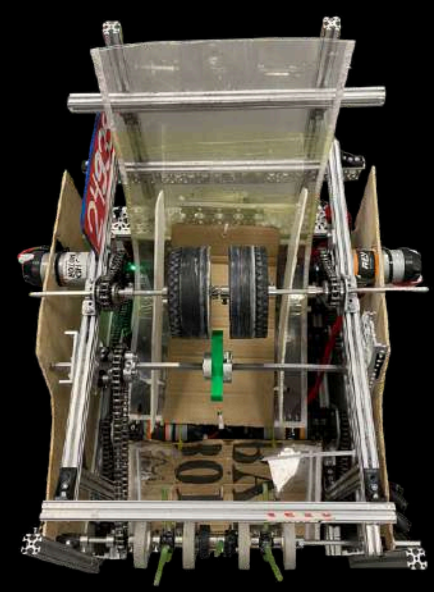
INTAKE SYSTEM (VERSION 1)

FIRST STAGE INTAKE

- Constructed using four compliant wheels
- The wheels were wrapped with medical silicone tubing
- This configuration provided high friction and compliance, allowing the robot to collect artifacts quickly and aggressively from various positions on the field

SECOND STAGE INTAKE

- Designed using CAD as a rigid guiding channel
- Its purpose was to transfer artifacts directly and precisely into the shooter system



INTAKE ADVANTAGES (VERSION 1)

1. Highly effective artifact collection performance
2. The compliant wheels in the first stage enabled fast and reliable pickup

INTAKE DISADVANTAGES (VERSION 1)

1. The rigid CAD-designed channel caused frequent jamming
    - Artifacts became stuck and could not pass into the shooter
    - This resulted in significant time loss during matches
2. Lack of precision in artifact transfer
    - Poor synchronization between the intake and shooter systems

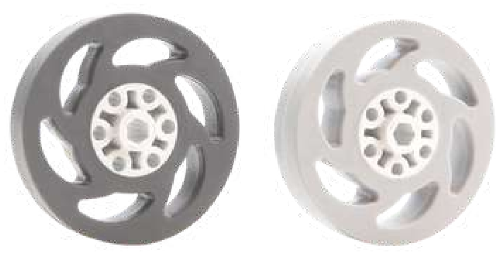
ROBOT EVOLUTION

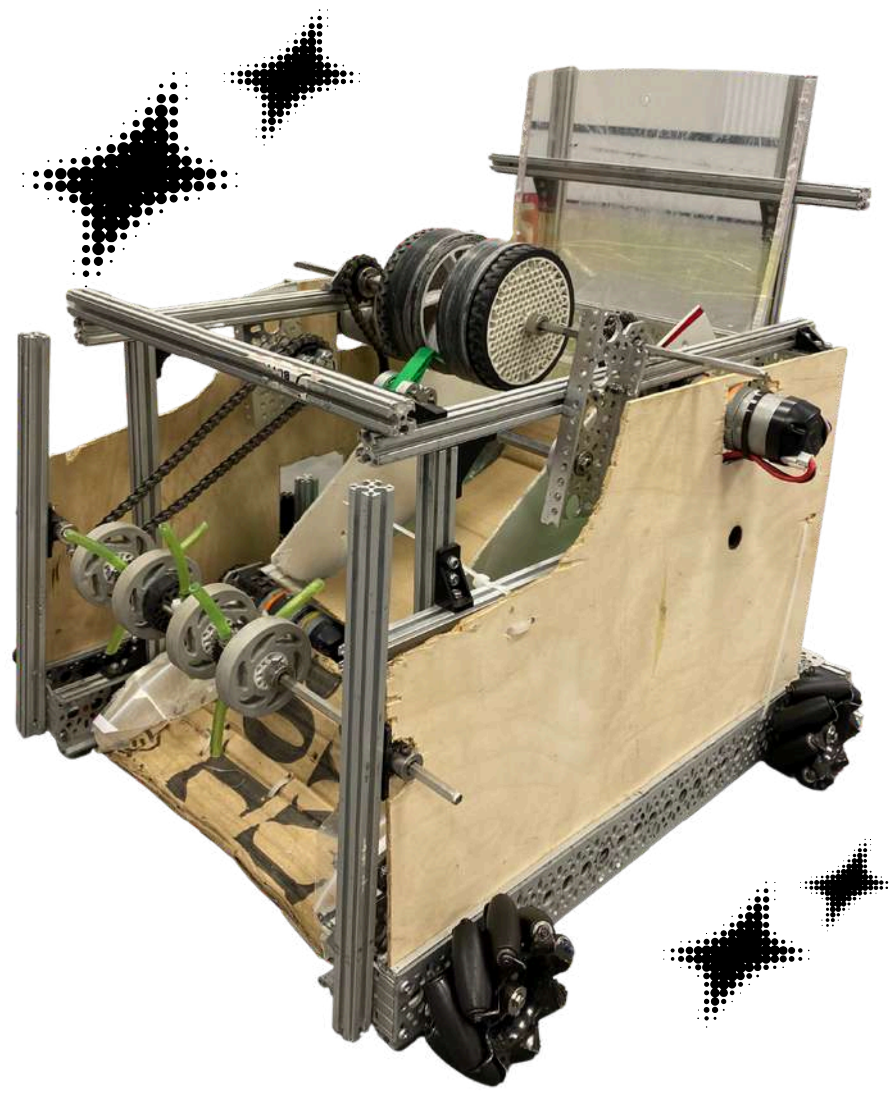
SHOOTER SYSTEM (VERSION 1)

The shooter mechanism was built using four REV wheels, including:

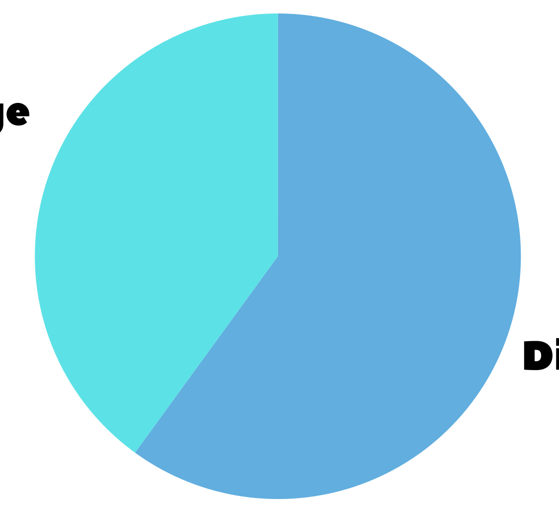
- **Duo Traction Wheels**
- **REV Wheels**

The shooter was mounted at a 90-degree angle.





90 degrees



1. **100% accuracy at close range**
2. **Very consistent scoring performance when artifacts were properly fed into the shooter**

Shooter Disadvantages

- **Inability to score from long distances**
  - **Insufficient exit velocity of the artifacts**
  - **Fixed geometry limited trajectory optimization**

Robot Version 1 demonstrated strong performance in artifact collection; however, the overall system reliability was limited by poor integration between the intake and shooter mechanisms. This version allowed the team to identify several critical engineering improvements:

- **The need to replace rigid transfer channels with more compliant or flexible solutions**
- **Improving precision and synchronization between intake and shooter**
- **Optimizing shooter geometry and energy output for long-range scoring**

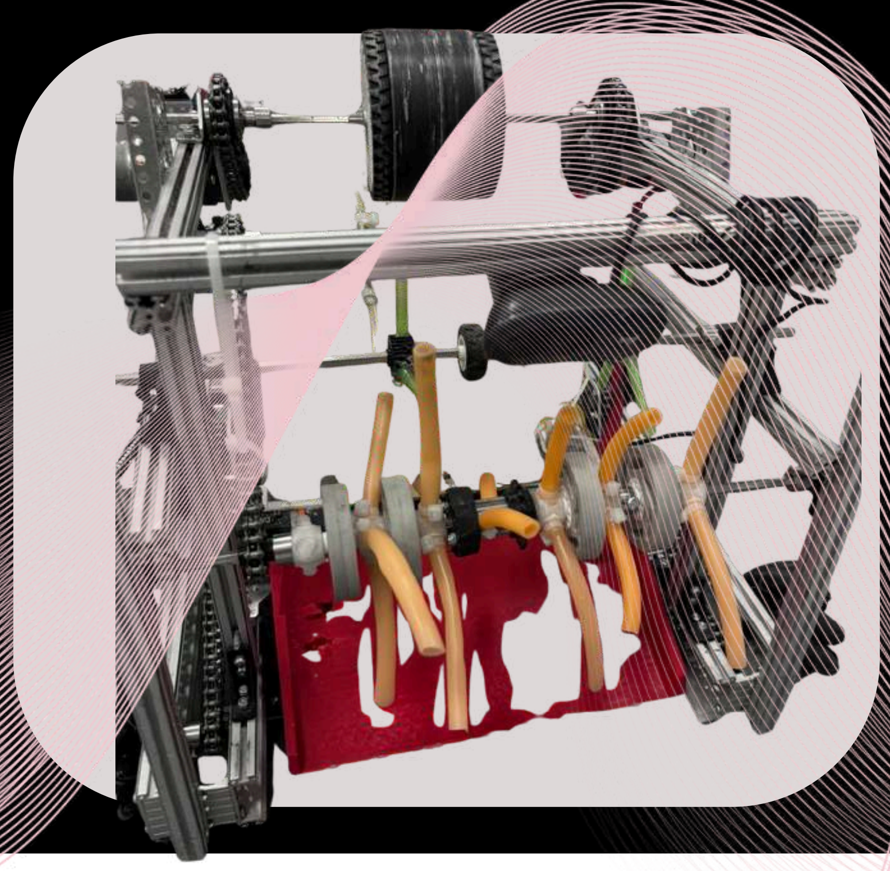
These findings were used as key engineering requirements for the design of Robot Version 2.

ROBOT VERSION 2 – ENGINEERING OVERVIEW

- Built using two 1312 Series Double Sonic Hubs (6mm D-Bore)

- Integrated with medical silicone tubing

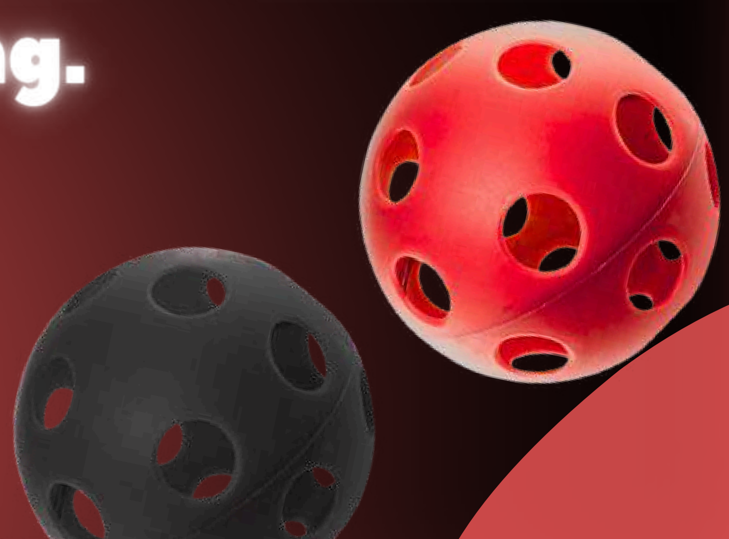
- Enabled rapid artifact capture and smooth transfer directly into the shooter

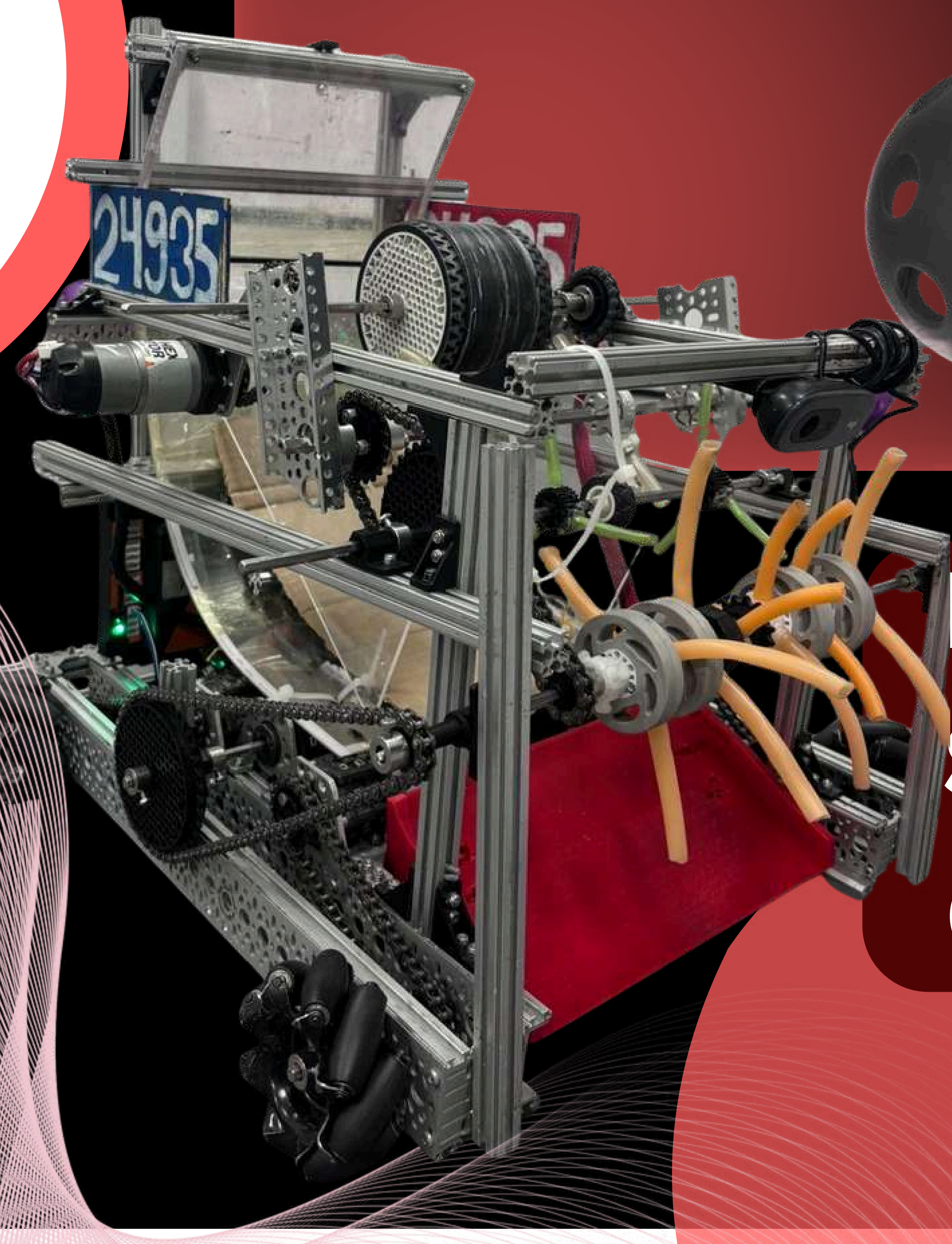


GENERAL DESCRIPTION

Robot Version 2 was developed based on the critical limitations identified in Version 1. The primary focus of this iteration was to improve shooting range, intake-to-shooter transfer reliability, and overall scoring consistency during matches.

The intake system was redesigned into a triple-stage (3-stage) modular collection mechanism, optimized for high-speed and consistent artifact handling.



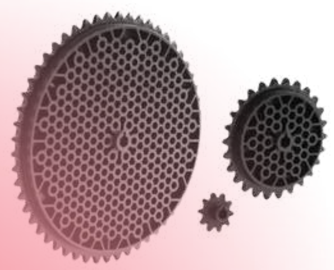


Intake System (Version 2)

SHOOTER

INTAKE PERFORMANCE CHARACTERISTICS

- **Gear system:**
  - **40-tooth gear**
  - **10-tooth gear**
  -
- **Operational speed: 1600 RPM**



High RPM ensured fast and reliable intake performance under high-pressure match conditions.

SHOOTER SYSTEM (VERSION 2)

The shooter angle was adjusted from 90 degrees to 75 degrees, representing the most significant mechanical improvement in this version.

Key improvements

- **Enabled both close-range and long-range scoring**
- **Optimized projectile trajectory for higher consistency**

SHOOTER MECHANISM

The shooter utilized a dual high-speed motor system to maximize power and precision.

- **Gear system:**
  - **20-tooth gear**
  - **30-tooth gear**
-
- **Speed per motor: 4000 RPM**

This configuration provided stable exit velocity and accurate artifact launching across multiple field distances.

VISION SYSTEM INTEGRATION

One of the most innovative upgrades in Version 2 was the integration of a Logi camera.

Vision Capabilities

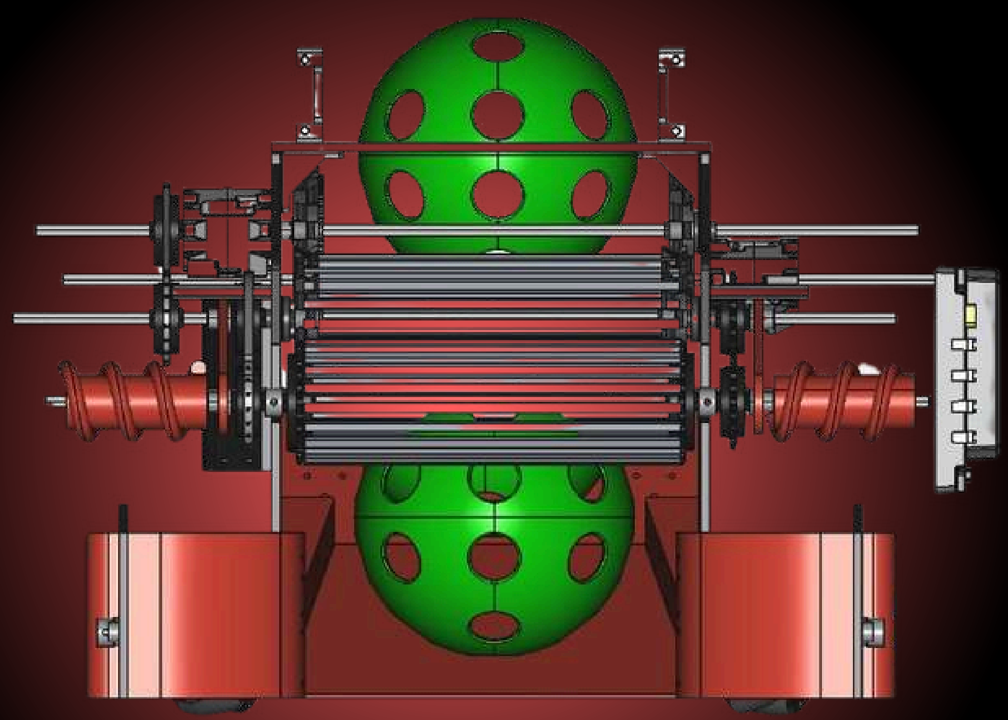
- **Artifact color detection**
- **Artifact shape identification**

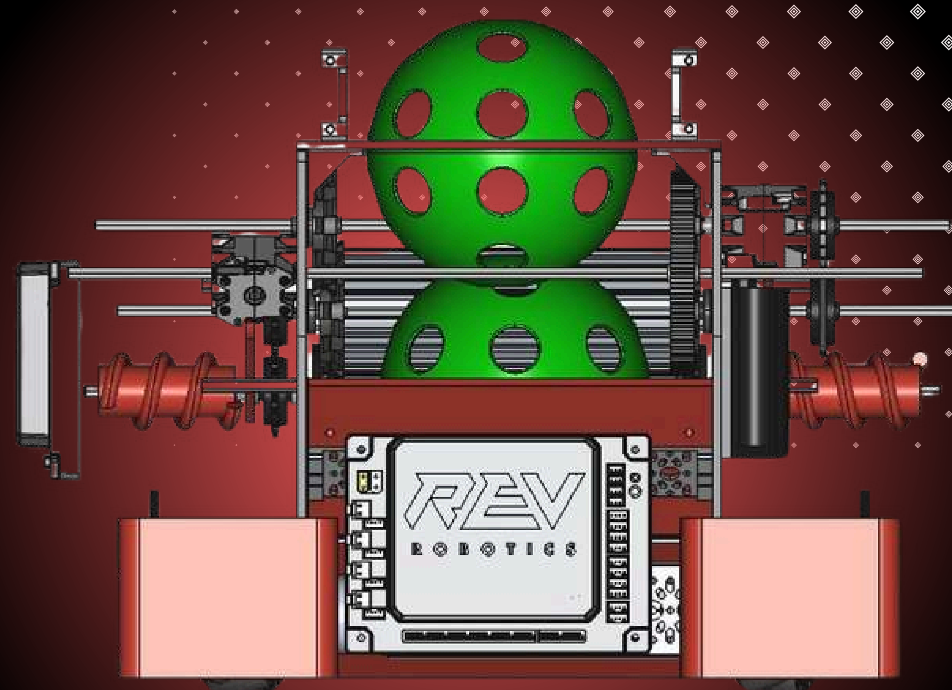
This system improved targeting efficiency and laid the foundation for advanced autonomous functionality.

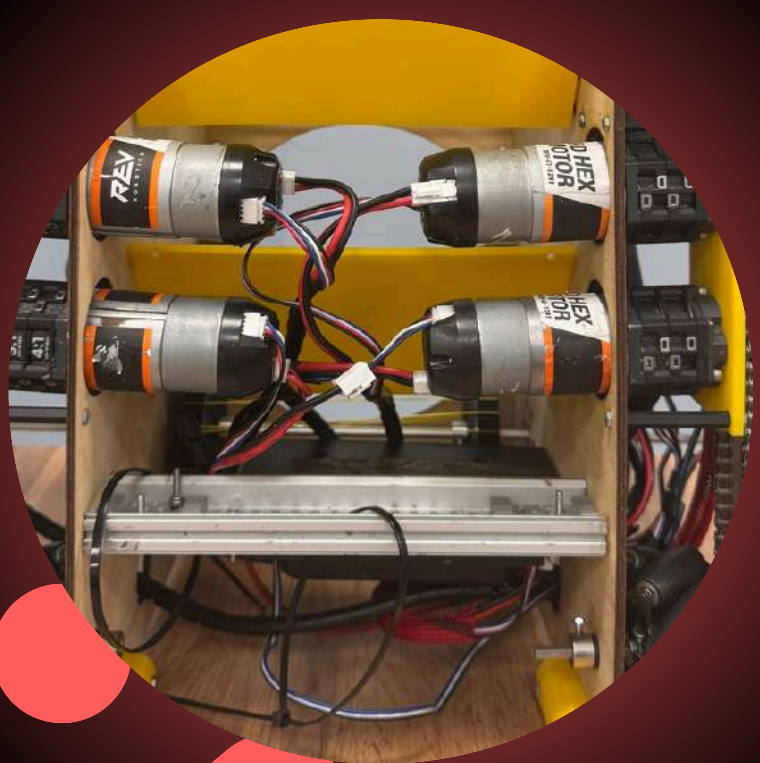
ENGINEERING CONCLUSION

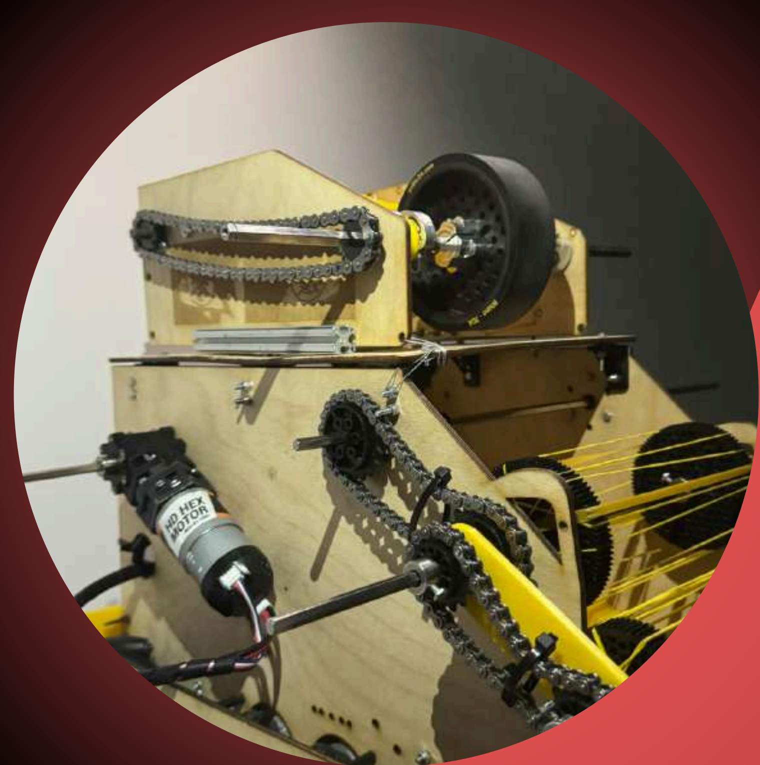
Robot Version 2 successfully addressed the major weaknesses of the first iteration. The introduction of a triple-stage intake, optimized shooter angle, high-speed dual-motor shooter, and vision system significantly improved scoring range, consistency, and match reliability. These advancements marked a critical step toward a fully competitive robot design.

VERSION 3 , OUR ROBOT'S CONSTRUCTION RIGHT NOW !

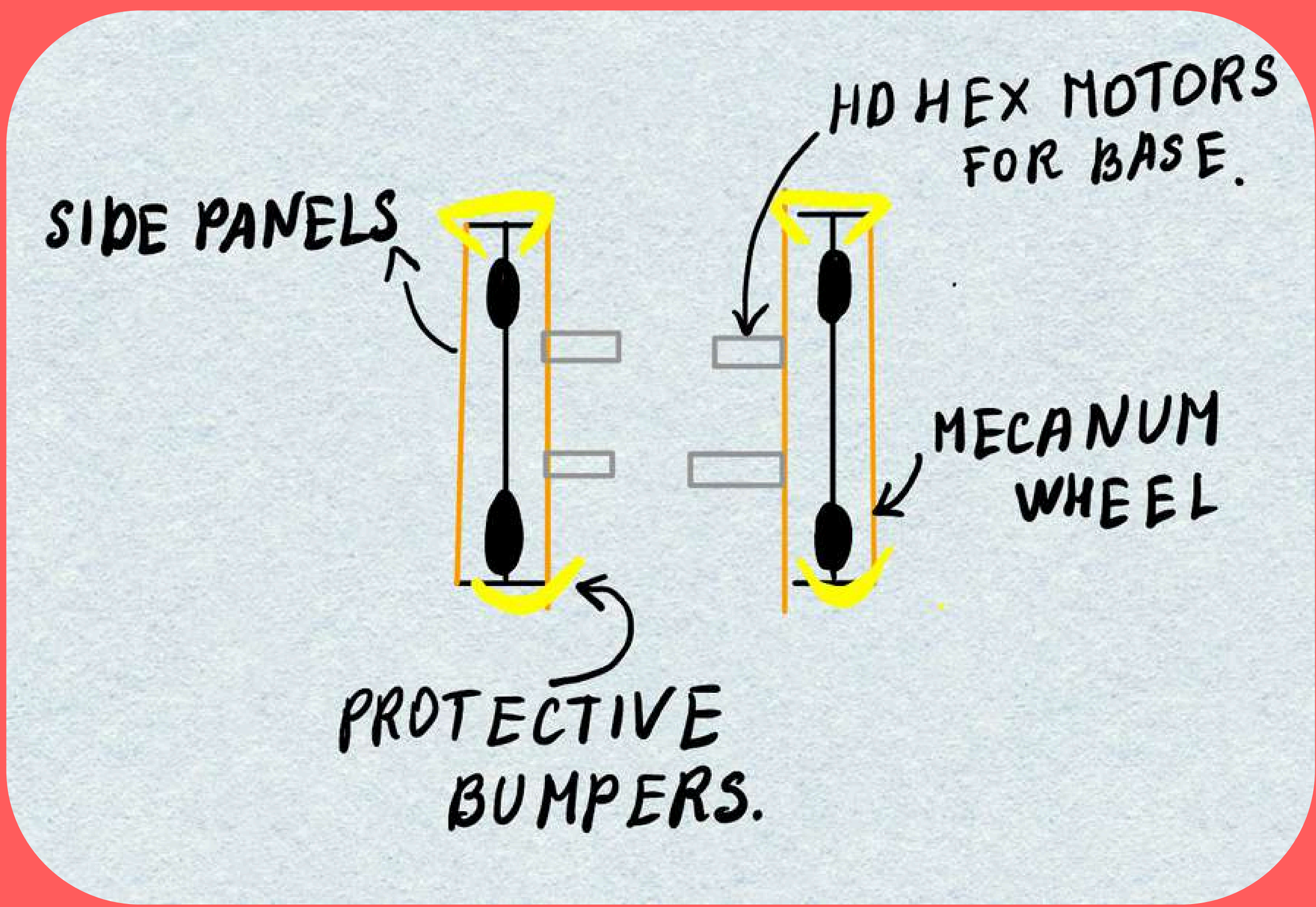








ROBOT BASE (DRIVETRAIN)



GENERAL DESCRIPTION

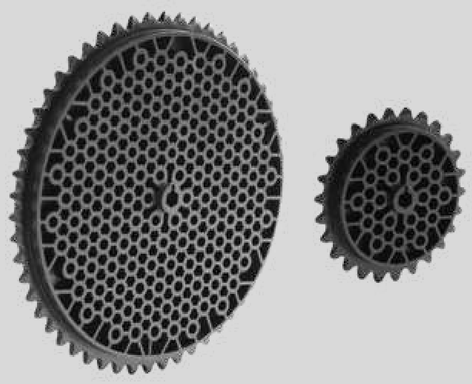
The drivetrain uses four mecanum wheels, allowing the robot to move forward, backward, sideways, diagonally, and rotate in place. The drivetrain is powered by four HD HEX motors.

All motors are mounted in the central part of the chassis, aligned parallel to each other:

- **two motors are positioned on the left side,**
- **two motors are positioned on the right side.**

This motor placement was chosen to optimize weight distribution and keep the center of gravity close to the center of the robot. As a result, the robot remains stable during fast movements and sudden direction changes, reducing the risk of tipping over while maintaining smooth, fast, and controlled motion.

MOTOR SPEED (ANGULAR VELOCITY)



-A 10 TOOTH SPROCKET
-A 15 TOOTH SPROCKET

The drivetrain frame is constructed using aluminum extruded profiles and C-channel components, providing high structural strength while keeping the overall weight low and allowing for easy assembly and maintenance.

ROBOT BASE (DRIVETRAIN)

3:1 4:1	3:1 4:1
3:1 4:1	3:1 4:1

HD HEX MOTORS.

Total 6000 RPM.

$$\frac{6000}{12} = 500 \text{ RPM}$$

HD HEX = 500 RPM (4).

Motor Speed (Angular Velocity).

$$\omega_m = \frac{2\pi \cdot RPM}{60} = \frac{6,28 \cdot 500}{60} = 52,3 \text{ рад/с}$$

Chain Gear Ratio.

1st Gear: 10

2nd Gear: 15

$$i = \frac{15}{10} = 1,5$$

$$\omega_{wheel} = \frac{52,3}{1,5} = 34,8 \text{ рад/с}$$

Linear Speed of the Robot

$$\upsilon = \omega_{wheel} \cdot r = 34,8 \cdot 0,035 = 1,218.$$

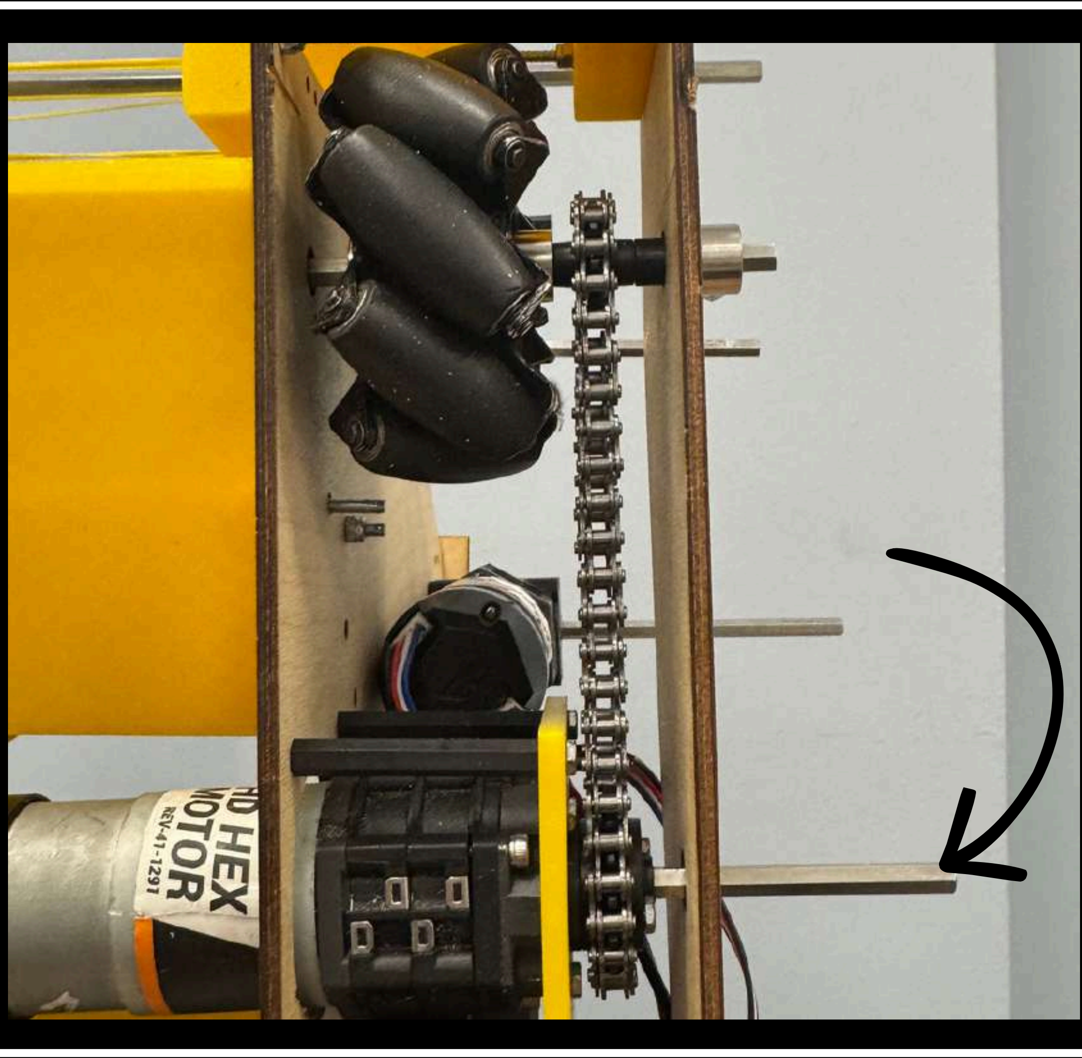
r (mecanum wheels) = 0,035.

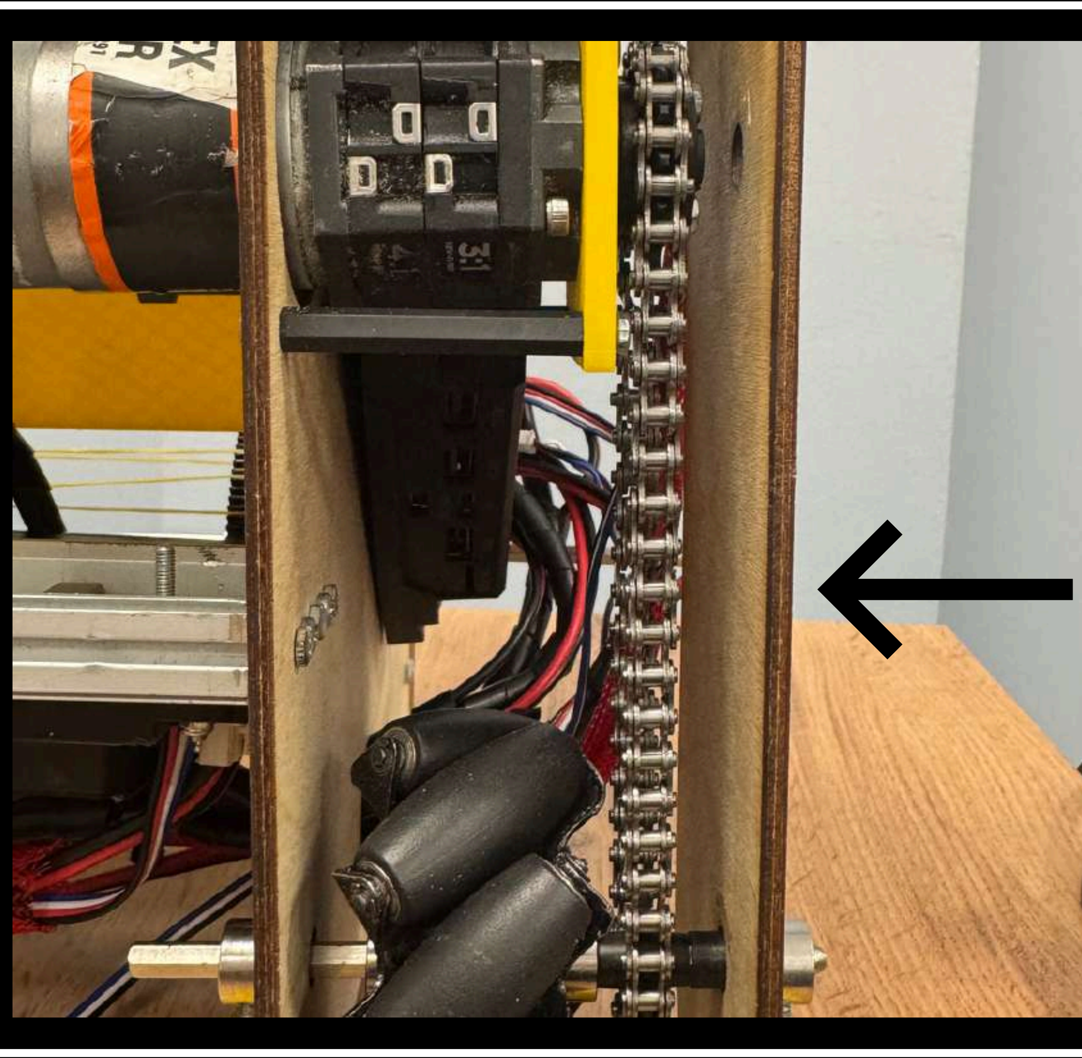
This speed will if on robot was only base but we have details like shooter , intake that add a lot of weights to base and this makes robots speed slowly.

PROBLEM & SOLUTIONS

DURING THE MATCH, THE SHAFT USED IN THE ROBOT'S DRIVE SYSTEM WAS NOT SECURELY FIXED.

When the motor was operating, the shaft became loose, causing the chain drive to slip and the chain to fall off. As a result, the wheel rotation became unstable, reducing the robot's overall movement efficiency.



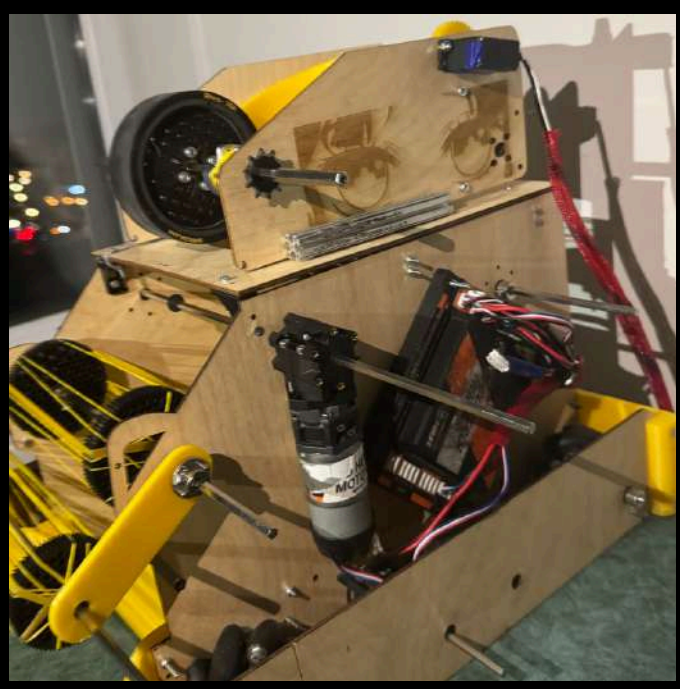


To eliminate this issue, we removed the shaft from the mechanism and directly mounted the gear onto the motor shaft (direct drive), securing it firmly. This solution reduced unnecessary mechanical elements and ensured direct and efficient torque transmission.

After the redesign, the chain derailment was completely eliminated, wheel rotation became stable, and the robot's overall reliability during matches significantly improved.

ROBOT DESIGN

The robotic system was developed through a systematic, evolutionary engineering approach, with each improvement enhancing functionality, reliability, and efficiency in line with modern iterative design principles.



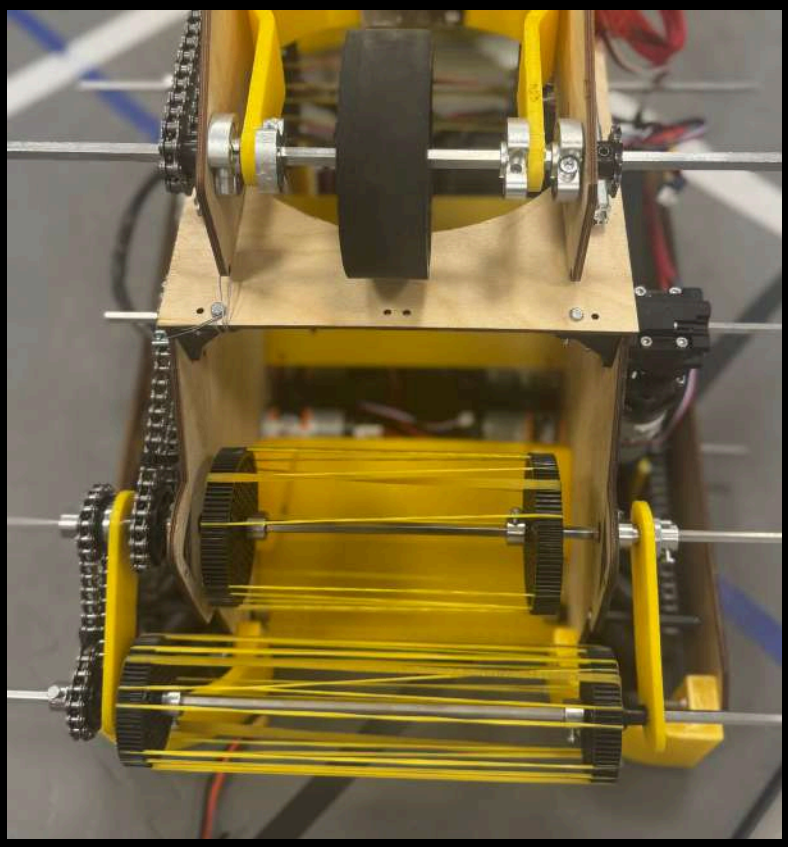
Initial Stage: Structural Design of the Robot

The first stage of the robot's evolution focused on developing its mechanical structure using a modular design, where key components functioned as independent units.

This simplified maintenance, allowed quick upgrades, and enabled future expansion. Special attention to stability and weight distribution improved control accuracy and reduced the risk of tipping, forming a solid foundation for further development.

INTEGRATION OF THE RUBBER-BASED INTAKE SYSTEM

At the third evolutionary stage, a rubber-based intake mechanism was integrated for object acquisition and transportation. Despite its structural simplicity, this solution demonstrated high reliability and efficiency.



The key advantages of the rubber intake system include:

- gentle yet secure object handling;
- the ability to operate at high speeds;
- reduced mechanical complexity, resulting in fewer potential failures.

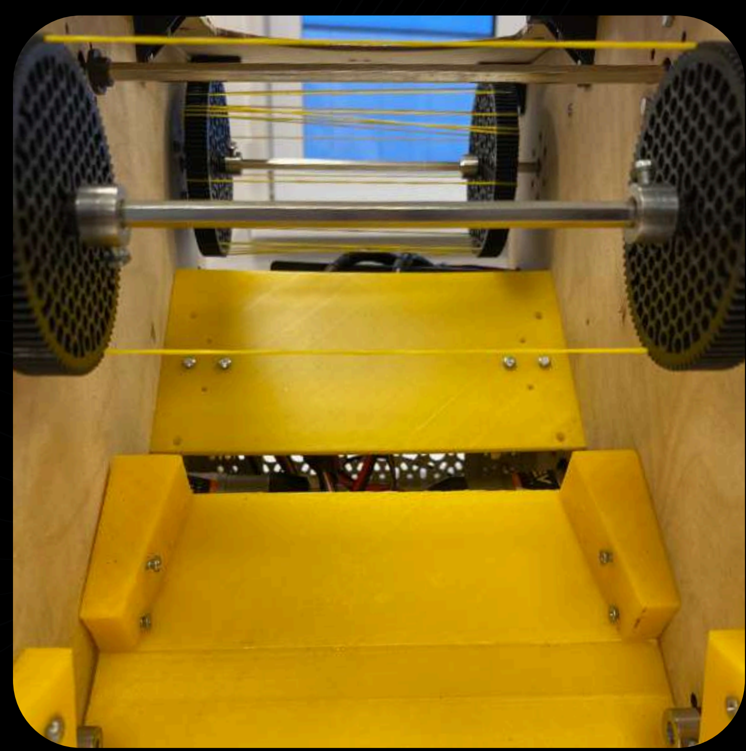
This mechanism not only increased the robot's overall operating speed but also improved system stability. The effective performance of the intake accelerated cyclic actions and elevated overall productivity.

ASPECT	DIRECTION
Function	Object acquisition and transportation
Adaptability	Handles objects of different sizes and surfaces; tolerates minor misalignments
Flexibility	Flexible material allows stable performance without precise positioning
Mechanical Simplicity	Few moving parts; low risk of failure; easy maintenance
Performance	Increases operating speed; accelerates cyclic actions
System Benefit	Improves fault tolerance, stability, and overall robustness

ENHANCED MULTI-STAGE INTAKE AND TRACK DELIVERY SYSTEM

The robot features an enhanced multi-stage intake and track delivery system, engineered to achieve high reliability, controlled artifact handling, and consistent shooter feeding under dynamic competition conditions

This system is specifically designed to minimize failure points during autonomous and driver-controlled operation by combining mechanical compliance, progressive geometry, and guided motion control



TRACK 2X

PROGRESSIVE INTAKE ARCHITECTURE

The intake mechanism is divided into three mechanically progressive stages, each optimized for a specific function in the artifact handling process.

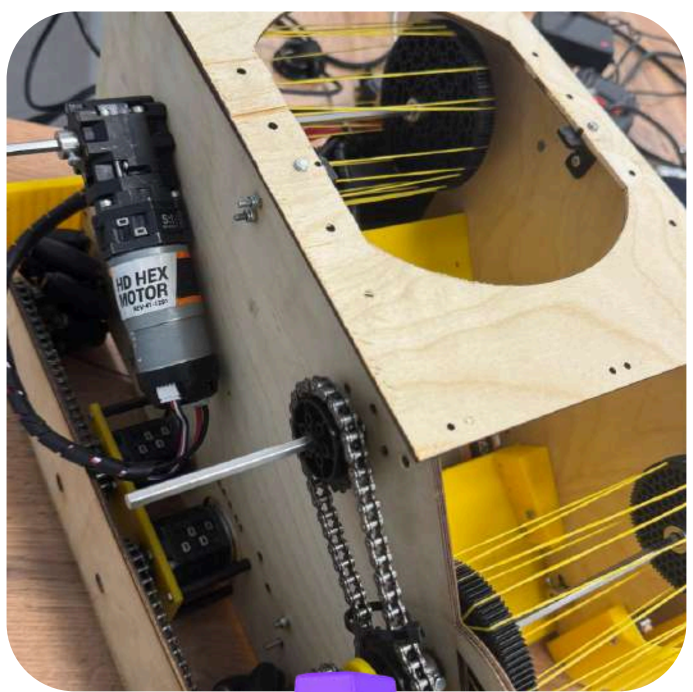
INTAKE 1ST STAGE

Adaptive Capture

- Utilizes hexagonal shafts with a 2.4 cm radius, covered with high-friction rubber elements.
- The compliant surface allows the intake to self-correct minor misalignments, increasing acquisition success rate.
- This stage prioritizes fast engagement and impact damping, stabilizing the artifact immediately upon contact.

INTAKE 2ND STAGE

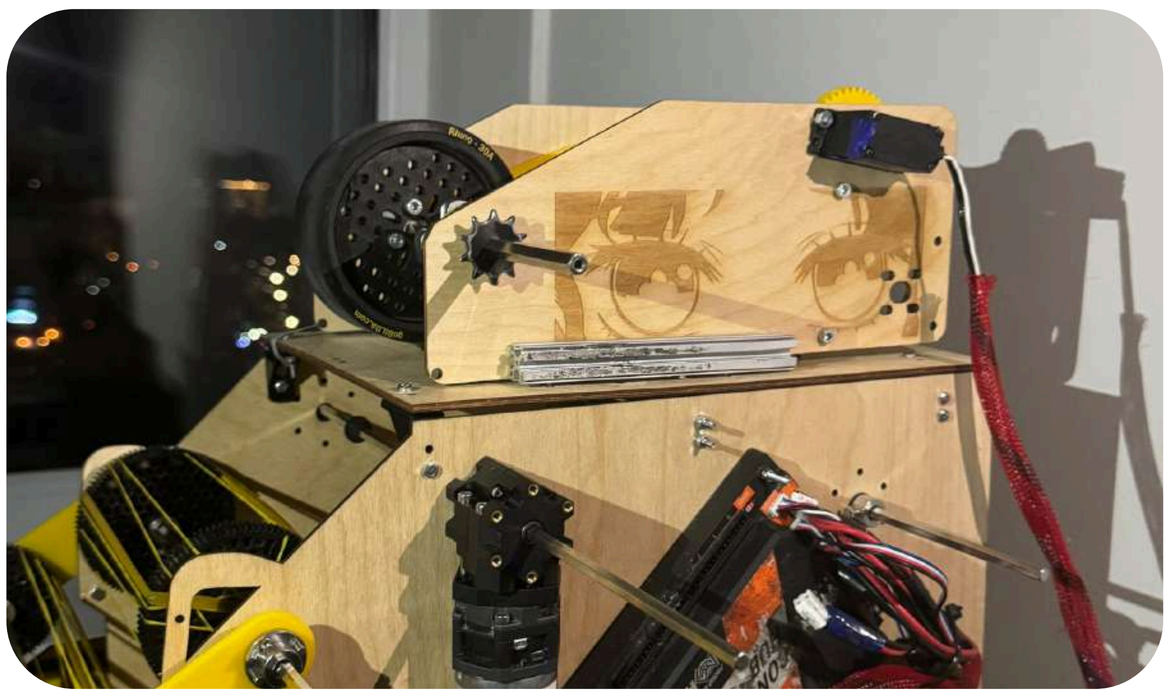
Stabilized Transfer



- Constructed using hexagonal shafts with a 3.0 cm radius, interconnected with rubber coupling elements.
- Provides a controlled transition between capture and alignment by gradually increasing contact surface area.
- This stage reduces slippage and ensures smooth, continuous artifact motion

INTAKE 3Rd STAGE

- Built around hexagonal shafts with a 4.0 cm radius.
- Ensures final alignment and velocity conditioning before shooter entry.
- The increased radius improves rotational consistency and prepares the artifact for accurate delivery.

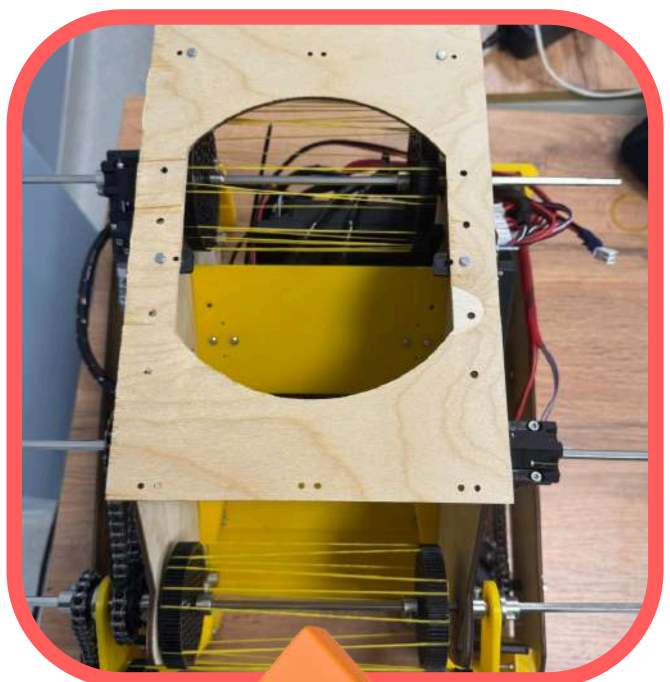


PRE-SHOOTER CONDITIONING

Precision Delivery to Shooter

FINAL DELIVERY STAGE

- Implements hexagonal shafts with a 4.1 cm radius, directly coupled to the shooter mechanism.
- Acts as the final control interface between intake and shooter, ensuring precise positioning and timing.
- This design significantly improves long-range shooting accuracy by maintaining repeatable entry conditions



DUAL TRACK GUIDANCE SYSTEM

To ensure reliable artifact transport, the system integrates two parallel track slide guides:

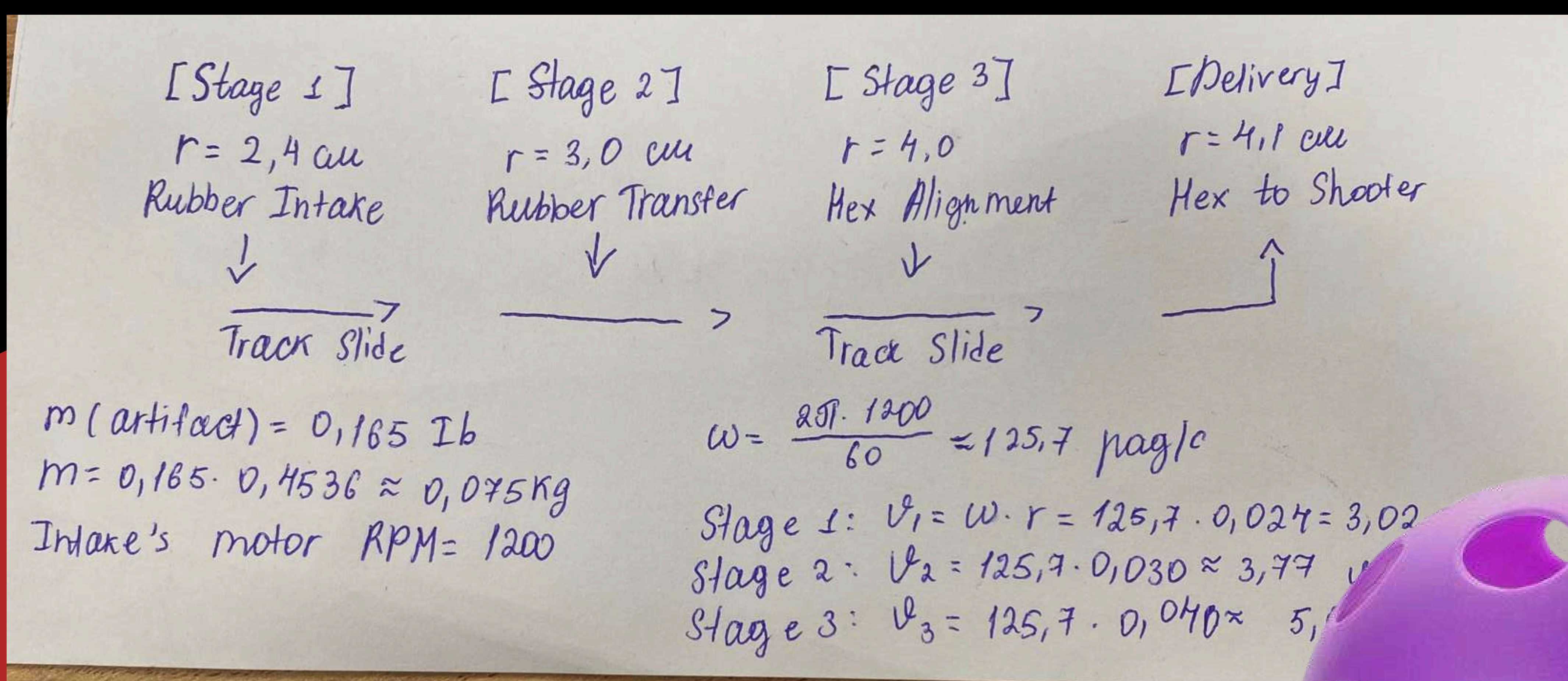
- Constrains lateral and rotational artifact movement throughout the entire transfer path.
- Maintains a consistent centerline, reducing mechanical stress and jamming probability.
- Enables higher operating speeds without sacrificing reliability.

INNOVATION AND ENGINEERING IMPACT

Key innovations of this system include:

- Progressive radius scaling, allowing controlled compression and smooth energy transfer.
- Mechanically guided alignment, reducing reliance on software correction.
- Modular stage separation, enabling rapid iteration and targeted optimization.

This approach demonstrates a system-level engineering mindset, where mechanical design, reliability, and repeatability are prioritized to achieve competitive performance



INNOVATION PART

AUTO AIM

AUTO DISTANCE

LOGI TECH CAMERA

Vision-Based Distance Recognition and Adaptive Shooter Control

System Functionality Overview

The camera performs continuous visual scanning of the field and detects a QR-code marker placed at a known reference location. This marker serves as a visual anchor, allowing the system to estimate the robot's distance to the target using image processing techniques.

Once the QR-code is detected and decoded, the system calculates the distance to the target based on:

- **the known physical size of the QR-code,**
- **its perceived size and position in the camera image,**
- **camera calibration parameters.**

DISTANCE CALCULATION AND CONTROL LOGIC

The computed distance value is processed in real time and passed directly to the shooter control algorithm. Based on the measured distance, the system dynamically adjusts the shooter's output parameters.

The control logic follows this principle:

- Greater distance → higher shooter power
- Shorter distance → lower shooter power

This closed-loop approach ensures that each shot is tuned precisely to current field conditions, eliminating the need for fixed power presets or manual tuning

REAL-TIME ADAPTIVE SHOOTER CONTROL

By coupling distance recognition with shooter power regulation, the robot achieves a self-adjusting shooting system. The camera continuously updates distance measurements, allowing the algorithm to compensate for:

- variations in robot position,
- small alignment errors,
- dynamic changes during autonomous operation.

As a result, shooter performance remains consistent and repeatable, even under non-ideal conditions

DISTANCE CALCULATIONS

$$D = \frac{W_{real} \cdot f}{W_{image}}$$

Parametres:

- Qr-code width: $W_{real} = 0{,}10$ m
- Camera focal length: $f = 700$ px
- Measured Qr-code width in image: $W_{image} = 140$ px

Calculation:

$$D = \frac{0{,}10 \cdot 700}{140} = 0{,}50 \text{ m}$$

Distance to target ≈ 0,5 m ✓

Qr-code width (px)	Distance D (m)	Shooter Power P
140	0, 50	0, 40
100	0, 70	0, 44
80	0, 875	0, 475

SHOOTER POWER MAPPING

Shooter Power Mapping

$$P_{shooter} = k \cdot D + b$$

Paramedres:

- $k = 0{,}2$, $b = 0{,}3$

Calculation:

$$P_{shooter} = 0{,}2 \cdot 0{,}5 + 0{,}3 = 0{,}4$$

Motor normalized power = 0,4 ✓

TELE OP

```
// ===== INTAKE =====
if (gamepad1.left_trigger > 0.1) {
    intake1.setPower(1.0);
} else if (gamepad1.left_bumper) {
    intake1.setPower(-1.0);
} else {
    intake1.setPower(0);
}

if (gamepad1.right_trigger > 0.1) {
    intake2.setPower(1.0);
} else if (gamepad1.a) {
    intake2.setPower(-1.0);
} else {
    intake2.setPower(0);
```

The first code segment addresses the control of the intake system, which is responsible for capturing, transporting, and ejecting game elements. Control is executed via gamepad input and is based on a clearly defined priority logic.

When the analog value of the left trigger exceeds a predefined threshold, the motor is driven at full power in the forward direction, ensuring reliable intake of objects into the mechanism. The introduction of a threshold effectively eliminates the influence of signal noise and guarantees predictable system behavior.

When the left bumper is pressed, the motor direction is reversed, allowing the mechanism to clear jams or intentionally eject objects. In the absence of any control input, the motor is completely de-energized, which improves energy efficiency and reduces mechanical wear. An analogous control algorithm is implemented for the second intake motor, providing structural symmetry and independent control.

TELE OP

The second code segment implements a **closed-loop speed** control system for the shooter motor using encoder feedback. When the shooter mode is enabled, the system performs precise measurements of **elapsed time** and changes in encoder position. Based on these values, the current rotational speed is calculated in revolutions per minute (RPM), providing an accurate representation of the **dynamic state** of the mechanism.

An **error signal** is then computed as the difference between the target RPM and the measured speed. The control output is generated using a proportional controller, where the motor power is directly proportional to the magnitude of the error. **Output clamping** ensures that the control signal remains within safe operational limits, preventing saturation and protecting the motor hardware. This approach provides stable and repeatable **shooter performance** and demonstrates a well-founded application of classical control principles.

In addition, telemetry data is generated to display the **system state** and real-time RPM values, significantly **enhancing system** observability and diagnostics.

```java
// ===== SHOOTER CONTROL =====
if (shooterOn) {

    long now = System.currentTimeMillis();
    int pos = shoot.getCurrentPosition();

    double dt = (now - lastTime) / 1000.0;
    int dTicks = pos - lastPos;

    double rpm = (dTicks / TICKS_PER_REV) / dt * 60.0;

    double error = targetRPM - rpm;
    double power = error * kP;
    power = Math.max(0, Math.min(1, power));

    shoot.setPower(power);

    lastPos = pos;
    lastTime = now;

    telemetry.addData( caption: "Shooter",  value: "ON");
    telemetry.addData( caption: "RPM", rpm);

} else {
    shoot.setPower(0);
    lastPos = shoot.getCurrentPosition();
    lastTime = System.currentTimeMillis();

    telemetry.addData( caption: "Shooter",  value: "OFF");
}
```

TELE OP

The third code segment implements **omnidirectional motion** using a mecanum drive. Gamepad inputs are converted into translational and rotational vectors, which are then transformed into power values for each drive motor. The **inverse kinematics** correctly combines translation and rotation, allowing the robot to move freely in any direction without changing orientation.

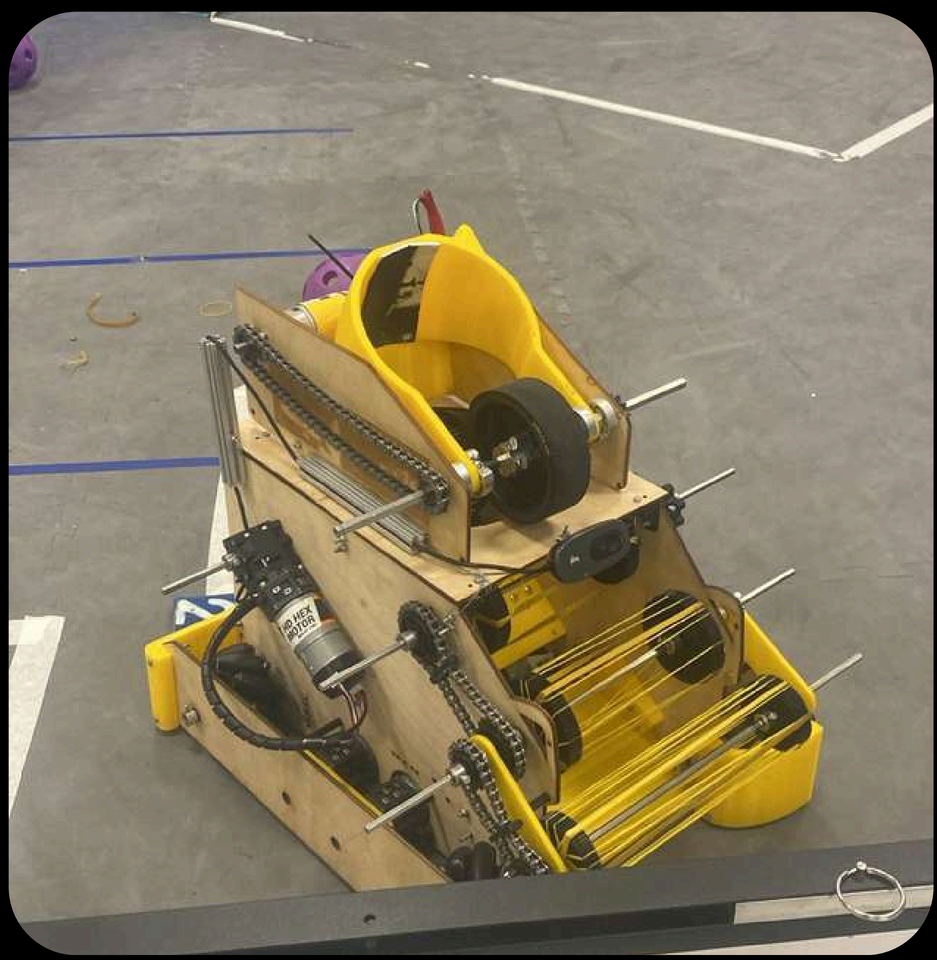
A **normalization procedure** ensures all motor powers are scaled relative to the maximum, preventing commands from exceeding limits while keeping the intended **motion characteristics.**

```
// ===== DRIVE CALCULATIONS =====
double x = -gamepad1.left_stick_y;
double y = -gamepad1.left_stick_x * 1.1;
double rx = -gamepad1.right_stick_x;


frontLeftPower  = -x + y + rx;
backLeftPower   = x - y + rx;
frontRightPower = -x - y - rx;
backRightPower  = x + y - rx;


// ===== NORMALIZE =====
double max = Math.max(
        Math.max(Math.abs(frontLeftPower), Math.abs(backLeftPower)),
        Math.max(Math.abs(frontRightPower), Math.abs(backRightPower))
);

if (max > 1.0) {
    frontLeftPower  /= max;
    backLeftPower   /= max;
    frontRightPower /= max;
    backRightPower  /= max;
}
```

Overall, this software is a robust control system, integrating **actuator control,** dynamic regulation, and precise motion modeling. It demonstrates a mature engineering approach and is an **exemplary example** of professional-grade robotic software.

LAUNCHER ANGLE ADJUSTMENT SYSTEM

The final and most critical evolutionary step was the implementation of a launcher angle adjustment system. This system significantly improved the robot's accuracy.



Precise angle calibration in degrees increased action repeatability and ensured consistent results.

ENGINEERING ANALYSIS SHOWS THAT THIS SYSTEM:

ENHANCED BALLISTIC ACCURACY;

ENABLED ADAPTATION TO TARGETS AT VARYING DISTANCES;

REDUCED ERRORS ASSOCIATED WITH HUMAN FACTORS.

This stage clearly demonstrated that the robot evolved beyond a purely mechanical device into an intelligent system based on precise calculations and controlled parameters.

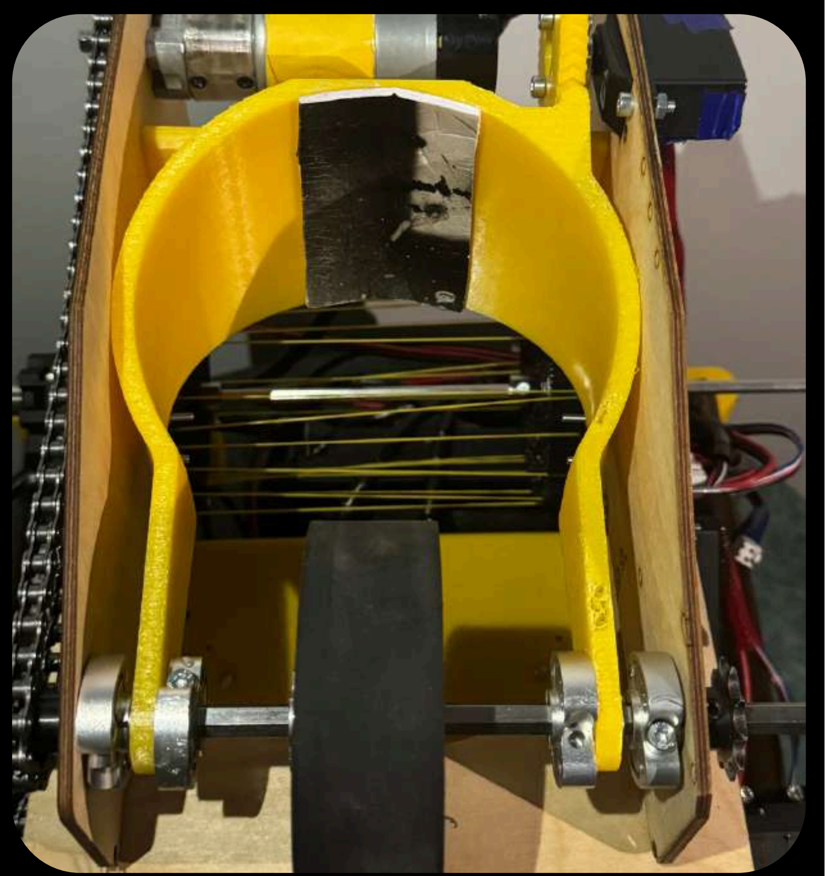
SHOOTER SYSTEM

INTRODUCTION

The shooter mechanism of our robot is designed to launch artifacts at varying distances with high accuracy and consistency. It integrates both **high-speed motors** and **precision servo motors,** which allow fine control over the shooting angle and velocity. The main goal of this subsystem is to ensure reliable artifact propulsion while maintaining structural and mechanical stability.

MOTORS

The system uses a **Gobilda 6000 RPM** motor as the primary propulsion unit. **Two servo motors** are integrated to control the shooting angle and provide feedback for distance-based aiming. The Gobilda motor is mechanically connected to the **Rhino 30A wheels** through a **shaft**, forming the main mechanism for launching artifacts.



MECHANICAL TRANSMISSION

The shooter motor is linked via a **shaft** and **chain drive** to the wheels, ensuring efficient torque transfer. The mechanical design reduces energy loss and prevents slippage, which is critical for consistent shot performance. The **regulator** allows angular adjustment, enabling the robot to shoot at both close and long-range targets.

CAMERA MOUNTING

A custom **3D-printed** holder is mounted on the front of the robot chassis to secure a **Loditech camera**, which assists in aiming and artifact tracking. The holder's placement and rigidity ensure that camera alignment is stable during operation.

SHOOTER

CONTROL SYSTEM

SHOOTER ANGLE ADJUSTMENT

The regulator is linked mechanically to the Gobilda shaft, allowing precise control of the shooting angle. By adjusting the regulator, the robot can dynamically modify the launch trajectory, adapting to different target distances.

MOTOR CONTROL

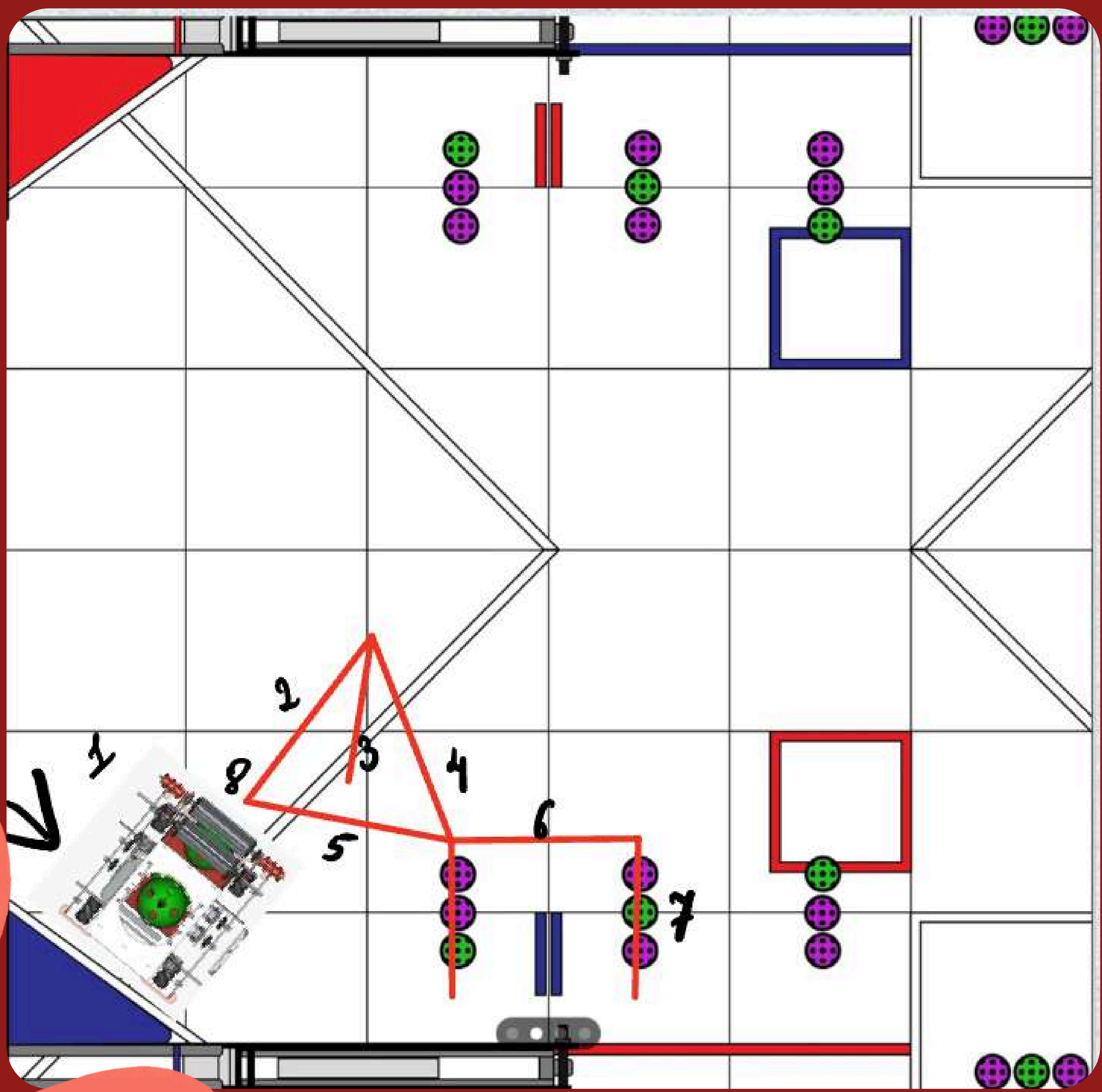
The motor is powered based on pre-defined speed requirements. The chain-shaft-wheel system guarantees smooth rotation and uniform artifact propulsion. Independent servo control allows angle adjustment without interrupting motor operation, improving overall system responsiveness.

The shooter system successfully achieves:

- Accurate projectile launch at varying distances.
- Reliable mechanical transmission with minimal energy loss.
- Dynamic aiming through the integrated regulator and servo motors.
- Enhanced targeting with the mounted camera, supporting both autonomous and manual adjustments.

The integration of high-speed motors, adjustable shafts, chain drive transmission, and precise servo control demonstrates a robust engineering solution suitable for competitive robotics environments.

AUTONOMOUS PERIOD



NEAR

9 ARTEFACTS

1 PERIOD PLAN

Duration: 30 seconds

Goal: Handle 9 artefacts automously

2 INITIAL ARTIFACT DEPLOYMENT:

- **Robot starts with 3 preloaded artefacts**
- **Launch artifacts into target zone using mechanical launcher**

3 POSITION ADJUSTMENT:

- **Move backward to clear deployment area**
- **Rotate 45° to align with next set of artifacts**

4 ARTEFACT COLLECTION:

- **Advance to collect additional artifacts using intake mechanism**

AUTONOMOUS PERIOD

ARTEFACT DELIVERY:

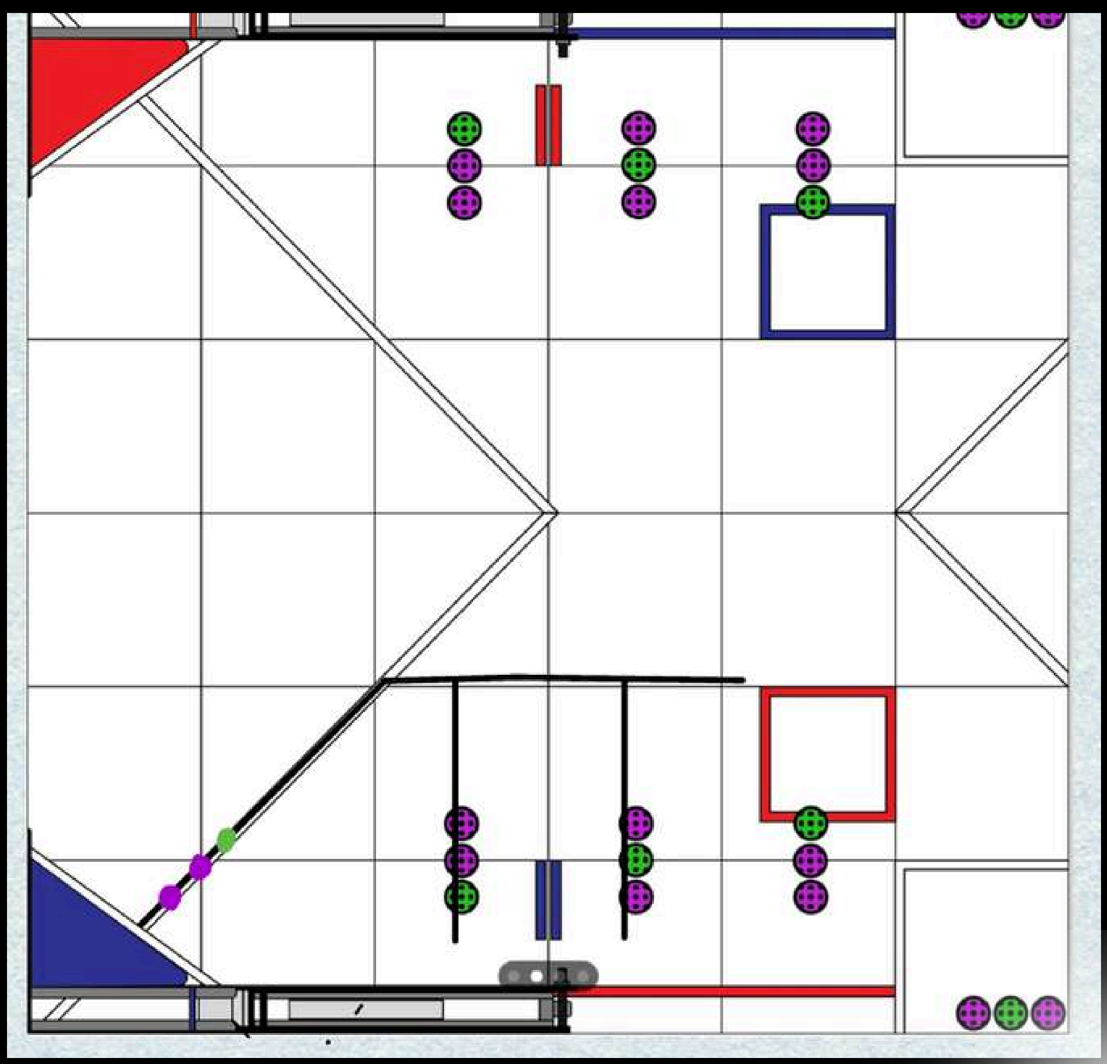
- Transport collected artifacts to scoring area
- Release artifacts accurately via delivery mechanism

FINAL POSITIONING:

- Return to designated safe position

NOTES:

- Fully autonomous; no driver control during this period
- Timing and distances optimized for maximum artifact handling
- Orientation adjustments ensure reliable collection and delivery

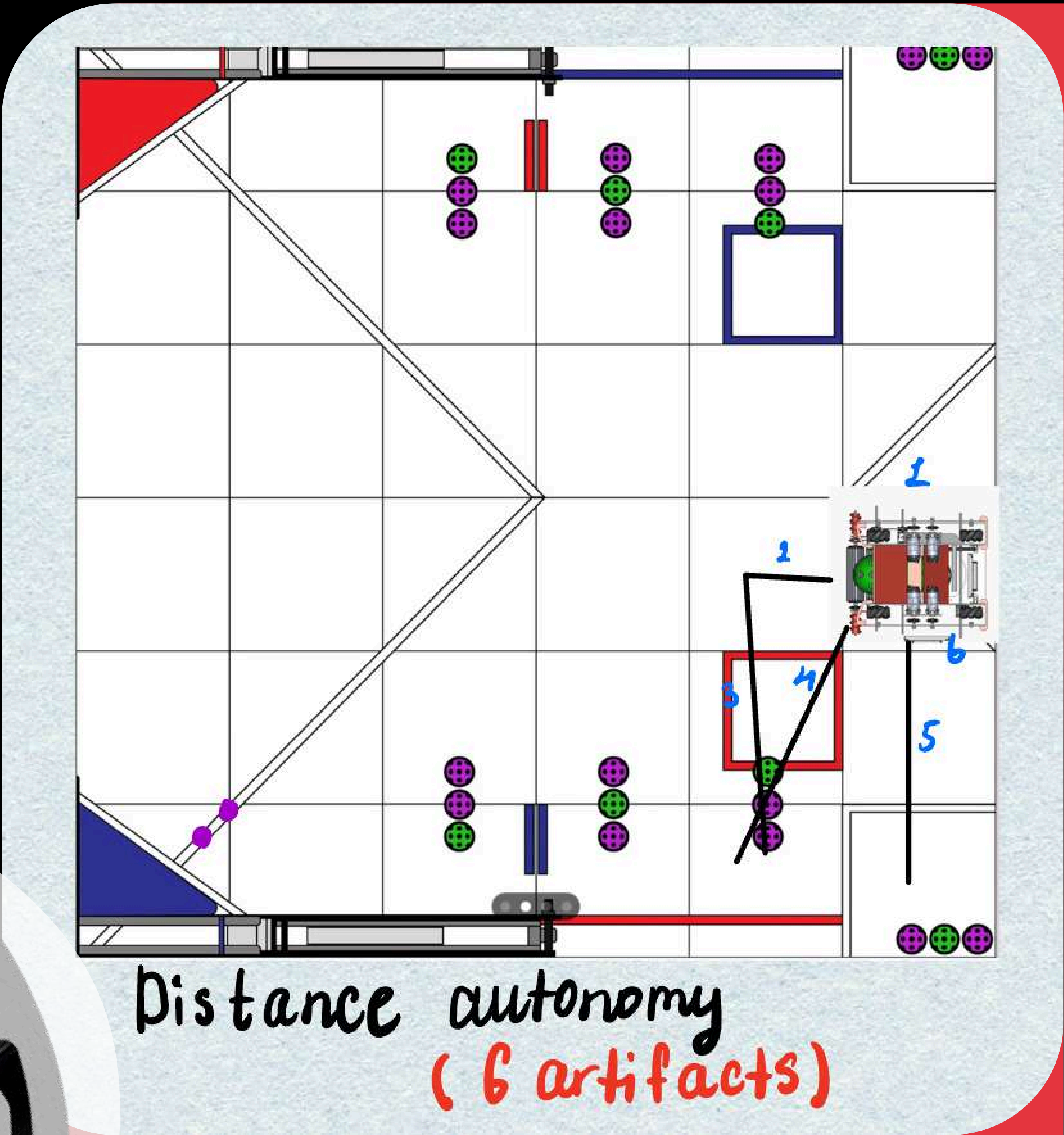


OUR TWO AUTONOMOUS

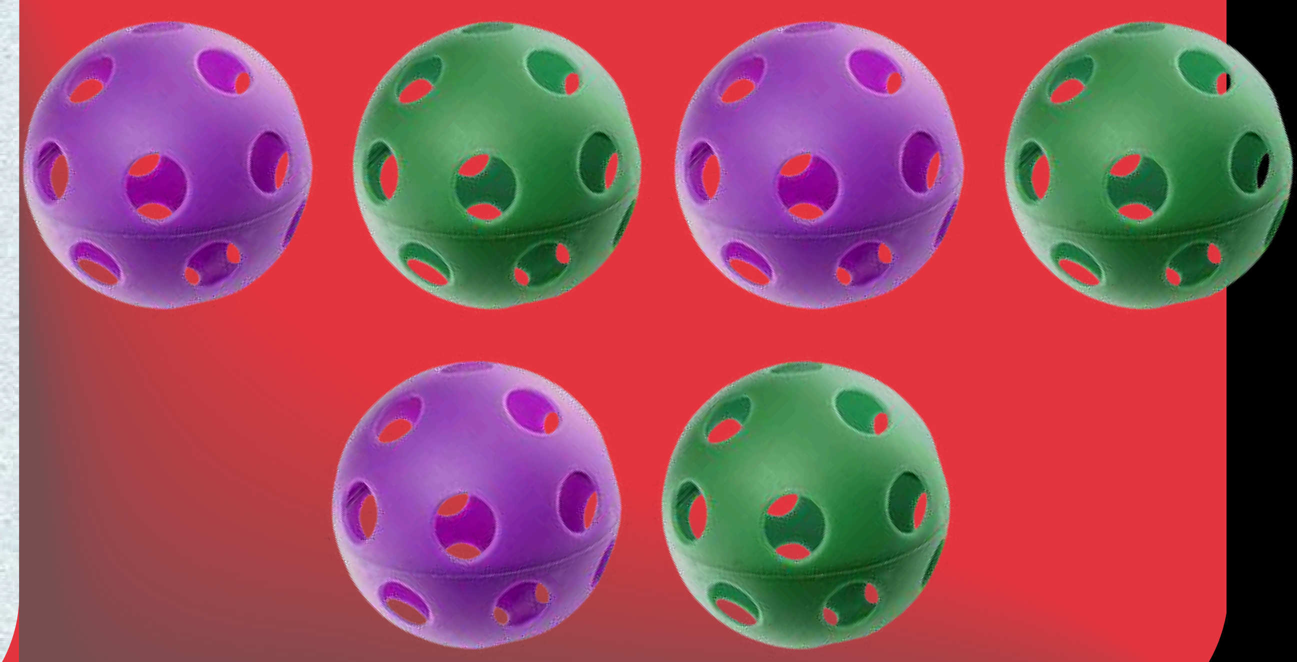
NEAR

DISTANCE

DISTANCE AUTONOMOUS PART



Long-Range Autonomous Mode — Award-Level Description



he primary objective of this autonomous mode is to accurately deploy six artifacts from a distance, reducing unnecessary drivetrain motion while maintaining high consistency across multiple autonomous cycles.

AUTONOMOUS OPERATION LOGIC

The long-range autonomous routine is divided into clearly defined system states, allowing reliable execution and easy debugging:

PRELOADED DEPLOYMENT STATE

- The robot begins with three preloaded artifacts.

After a short, controlled movement to a calibrated launch position, the robot deploys all three artifacts using a long-range launcher.

- Motor power and timing are regulated to ensure repeatable launch trajectories.

DISTANCE AUTONOMOUS PART

COLLECTION STATE

- The robot transitions into an autonomous collection phase.
- Three additional artifacts are acquired using an intake system optimized for alignment tolerance and acquisition speed

SECONDARY DEPLOYMENT STATE

- The robot returns to the predefined launch position.
- The collected artifacts are deployed using identical launch parameters, ensuring consistent performance across both cycles

STABILITY AND ACCURACY CONSIDERATIONS

This autonomous strategy prioritizes system stability over aggressive movement:

- Reduced drivetrain motion minimizes incoder and alignment errors.
- Balanced robot mass and centralized drivetrain reduce vibration during launching.
- Identical launch parameters ensure predictable results across multiple runs.

These design choices result in a highly repeatable and competition-ready autonomous system

DISTANCE AUTONOMOUS PART

INNOVATION HIGHLIGHT OF CODE

Key innovative aspects of this autonomous mode include:

- Separation of autonomous strategies into near-range and long-range modes, enabling adaptive match planning.
- Use of state-based autonomous architecture, improving reliability and scalability.
- Emphasis on consistency and precision, rather than maximum speed, reflecting real-world engineering practices.

This approach demonstrates how mechanical design, control theory, and strategic thinking are integrated into a single robust system

Our long-range autonomous mode demonstrates engineering maturity by focusing on precision, stability, and repeatability. Through a structured state-based design and optimized launch control, the robot reliably deploys six artifacts from distance, reflecting our team's commitment to robust, competition-ready engineering solutions.