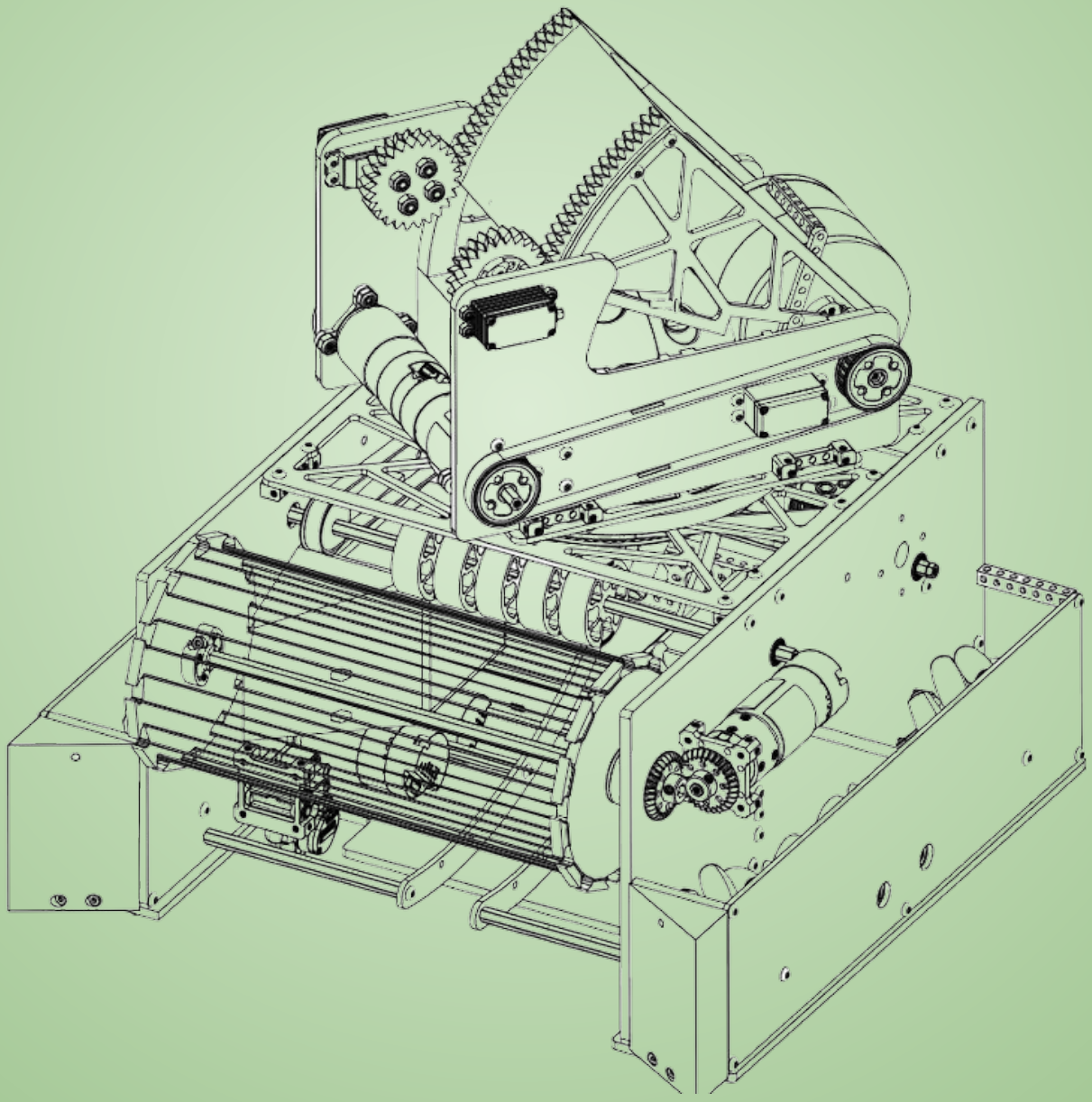
ENIGMA #16265
2025-2026
Portfolio



"BADGER"

Team Members

Coach Russ

7th year of robotics

Technical Coach

Coach Dan

4th year of robotics

Managerial Coach

Luke (Age 17)

5th year of robotics

Co-Captain, Design, Build, Drive Teams

Callie (Age 15)

4th year of robotics

Co-Captain, Build, Business, Drive Teams

Elliott (Age 14)

4th year of robotics

Programming, Drive Teams

Gabriel (Age 14)

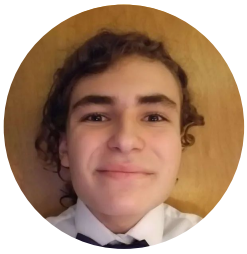
3th year of robotics

Build, Drive Teams

Anirudh (Age 17)

3rd year of robotics

Design, Build, Drive Teams



Cody (Age 17)

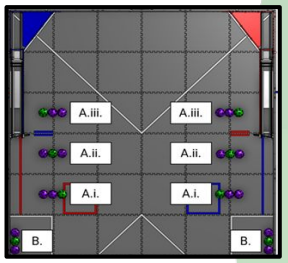
3rd year of robotics

Business, Art Teams

Game Strategy

Innovate

Scoring Priorities



- Cycle Speed
  - From the point distribution, we realized that the best way to maximize scoring capability was by having a design built to be incredibly fast-paced.
  - This helped us determine that artifact sorting did not align with our season goals; additionally, approximately half of the pattern points would still be achieved through random launching of artifacts.

- Shooting range
  - We understood that scoring fast was crucial to helping achieve our season goal of being an incredibly fast shooter, in addition, we understood that the open-field nature of the game meant that we had to be able to score effectively from anywhere on the field.
  - We decided that a turret that allows scoring in any orientation, as well as the ability to score from different ranges would also maximize our scoring capabilities.

Aesthetics

- Bright Green 3D printing allows us to show off our style while giving us the additional advantage of being able to design our own parts
- ¼” Wooden Plates are a new part of our aesthetic this year creating a more non industrious look. These are quick to manufacture and much cheaper so we can iterate quickly.
- ⅛” Aluminum CNC Plates give us a final industrial look. These are very solid and allow us to not be worried about breaking in a match
- ¼” Polycarbonate plates allow us to quickly manufacture strong, ductile parts.

Robot Efficiency

- With a “touch it own it” rubber band intake, our robot is able to easily grab artifacts quickly and efficiently.
- Our parallel plate drive system makes the inside of our robot easily accessible, allowing for repairs to be much faster.
- The robot is built to be able to shoot from many different areas of the field so we don’t waste time driving around the field.
- We decided to go for a very modular design, allowing for mechanisms to be swapped and replaced with just a few screws so we don’t waste time disassembling the entire robot for one mechanism.

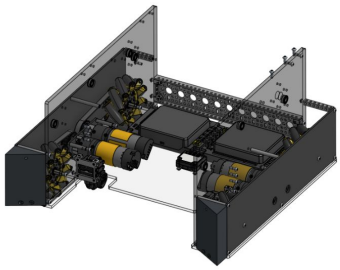
Badger's Design

Drive Base

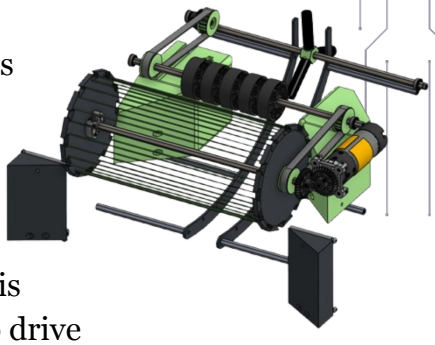
The drive base features a parallel plate design with goBILDA GripForce mecanum wheels.

This year, ¼-inch oak plywood replaced traditional ⅛-inch aluminum for our v1 design. Following the Alamogordo qualifier, we decided to swap our wood plates for ¼-inch polycarbonate plates. This allowed for a more rigid design, tighter tolerances, as well as allowing for better visibility for the driver.

The parallel plate design allows for fully customizable mounting as well as providing a rigid base.



Intake



Extensive game analysis revealed that intaking was by far the most important aspect of DECODE. Our main goal when designing this intake was to be able to drive into the stacks of three and intake without slowing down.
In order to accomplish this, we utilize a three stage intake consisting of:

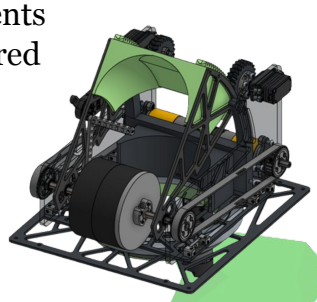
- 1st stage: 4.5in rubber band roller
- 2nd stage: 48mm flex wheels
- 3rd stage: 3in surgical tubing roller

Shooter

Badger's shooter employs a hooded flywheel design, powered by two 96mm flywheels which are driven by two 6000 rpm motors.

The shooter also includes an adjustable hood powered by an AXON servo, allowing for an adjustable range of shots from various positions on the field.

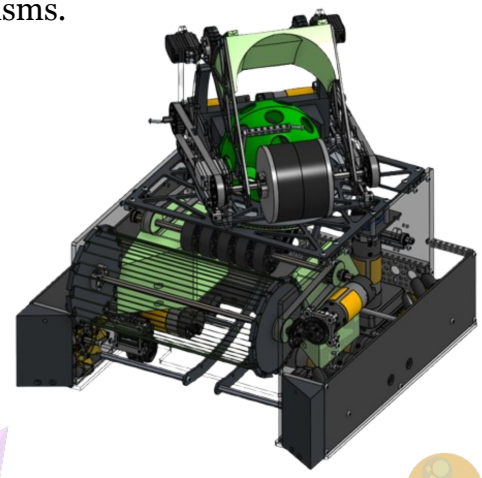
Additionally, a Axon mini servo actuates a gate mechanism that prevents artifacts from being fired prematurely.



Modular Design

Badger is designed and built around the engineering principle of modularity. Each individual mechanism is designed to be easy to detach, disassemble, and improve without affecting other subsystems.

Modularity allows the engineering design process of Badger to be seamless, as changes are able to be made quickly without affecting other mechanisms.



Engineering Process Highlight: Intake Mechanism

Think

Problem Scoping:

- After the game announcement, we decided that a fast and efficient intake would be a key metric in determining success on the field.
- Key decisions we made early included deciding against a claw intake, and in favor of some type of rolling “touch it own it” intake.

Design Prototype:

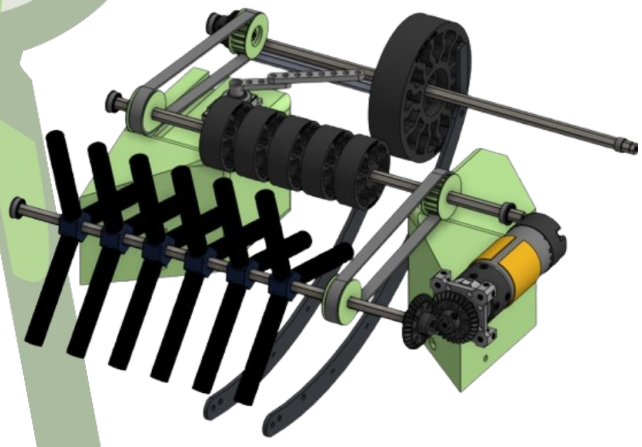
- Early intake prototypes used a drill for testing of various different roller types including surgical tubing, flex wheels, and rubber band wheels.
- Our original conclusion from our prototypes was that surgical tubing offered the best intaking ability of the options.

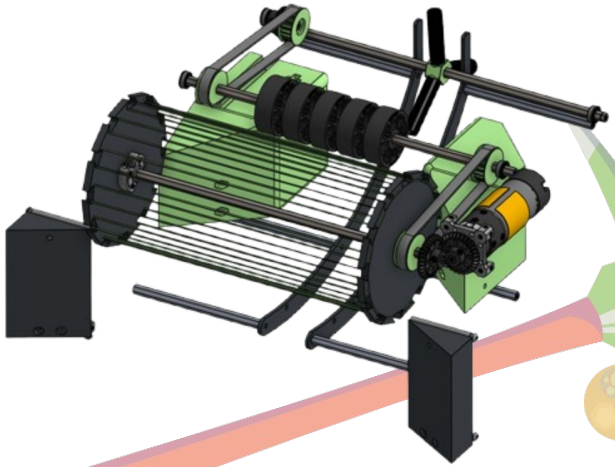
Design:

- Initial Intake Design Involved using an initial stage of 3 inch surgical tubing, a second stage of 48mm flex wheels, and a third stage consisting of a single 96mm flex wheel in order to kick the ball up into the shooter.
- Our Intake is powered by a single 1150 RPM motor, using a bevel gear to transmit power to the initial shaft, a set of 3d printed pulleys to transmit to the second shaft, and a belt + gear combo to reverse the direction of the third shaft.
- Additionally, We used two 3d printed blocks to funnel the game pieces into the center of the robot, with a servo actuated gate mounted on the shooter to block artifacts from shooting until we were ready to fire.

Re-design:

- After testing our intake on the field, we noticed a couple of issues:
  - The surgical tubing rollers struggled to lift the artifacts onto the ramp when intaking multiple in a row
  - The large flex wheel in the back lacked enough force to consistently launch the artifact into the shooter
- To fix these issues we:
  - Switched the surgical tubing rollers out for rubber band rollers
  - Switched the large flex wheel in the back out for surgical tubing





Engineering Process Highlight: Intake Mechanism

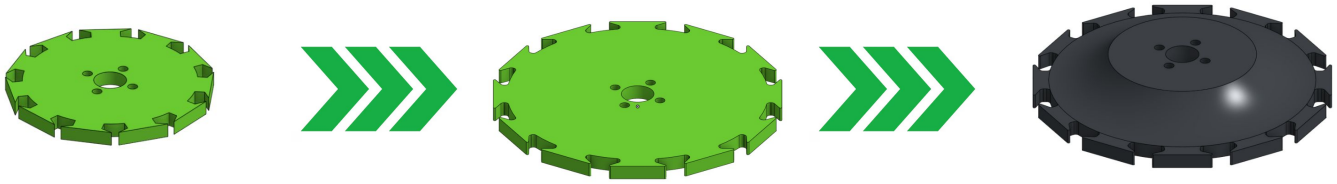
Think

Retest:

- After switching from surgical tubing to rubber band rollers, we tested multiple sets with different diameters, ranging from 3 inches to 4.5 inches.
- After testing, we found that the 4.5 inch diameter rollers worked best for intaking.
- Additionally, we found that switching the large flex wheel in the back to 3in long tubing, provided the best result, allowing us to consistently feed artifacts onto the shooter.

Finalize:

- After running the intake in practice for a few days, we decided to switch to a different types of rubber bands with more stretch, allowing the rubber bands to break less often.
- Additionally, we encountered an issue where two balls could get stuck side by side. To fix this, we widened the intake by 1.5 inches, allowing us to prevent this.
- Finally, we added grip tape to the front of the intake ramp, helping give the intake more grip, and increasing intake consistency.
- After breaking one of our rubber band holders at a competition we decided to change our design to improve durability, reprinting the hubs thicker, and with 1.5in diameter fillets facing inwards



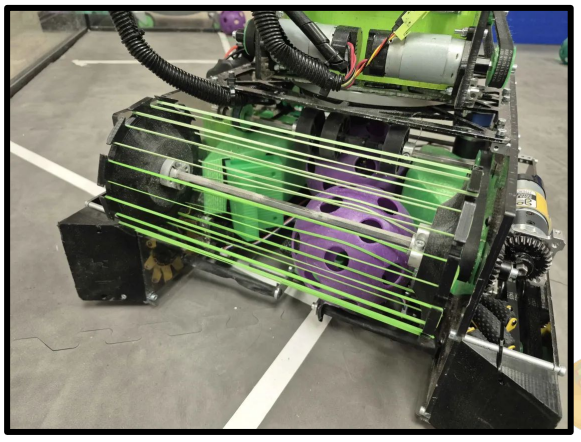
V1 - 11/28 V2 - 12/10 V3 - 2/7

Deployment:

- After finalizing our intake design, we switched our wood rubber band holders out for a stronger, more permanent 3d print.
- In testing and in practice matches it has performed very well
- The intake has had no issues with breaking, and has stayed working consistently throughout practice.

Conclusions:

- Throughout the early season, while keeping the same basic design, we were able to improve our intake by making gradual small improvements.
- These improvements to our intake allowed for us to greatly speed up our cycle speed and improve our general robot performance and consistency.



Robot Design Highlight: Launcher/Turret

Innovate

Design Goals

This season we had three main design goals for our artifact launcher system

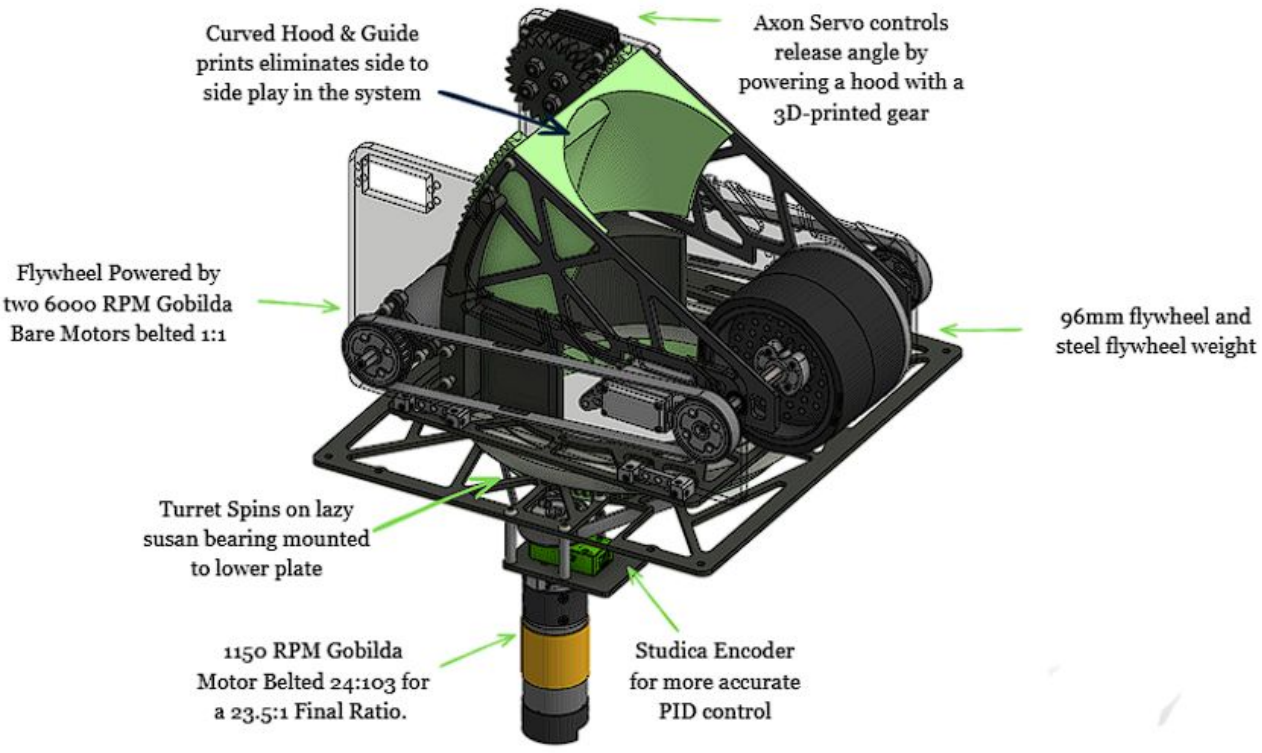
- Fire all three artifacts in less than a second with minimal drop off
- Be able to shoot from different positions spanning as much of the field as possible
- Minimize the movement, especially turning, of the robot during gameplay

Our Solution

In order to maximize our fire rate and shot consistency, we decided to use a weighted flywheel system fed directly from the intake. A steel flywheel weight increases the systems inertia, allowing us to minimize the loss of speed between shots and maximize our shot consistency. This allows us to fire all 3 balls rapidly, without waiting for the flywheel to spin up between shots.

Additionally, to score from as many positions on the field as possible, we decided design a custom adjustable hood, giving us an additional method of controlling distance through release angle.

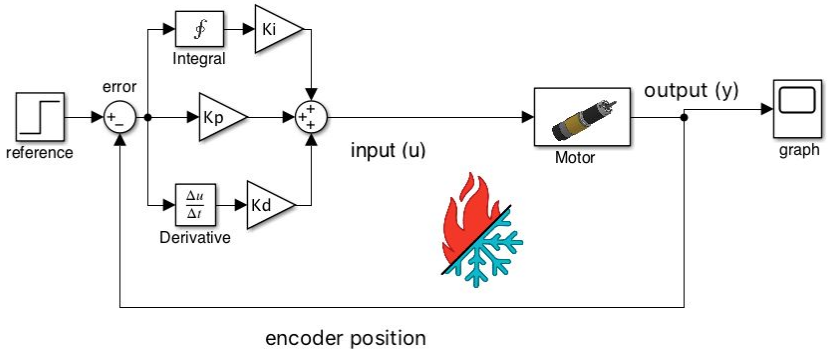
Finally, to minimize the time spent aligning the robot to the goal, we designed a turret system that automatically tracks the goal independent of the rest of the robot. This allows us to minimize the time spent lining up before scoring artifacts.



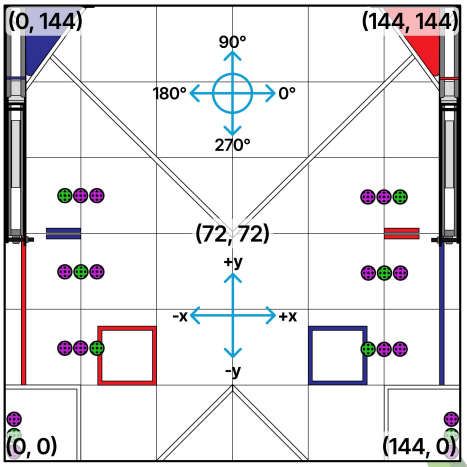
Programming and Feedback

Control

- Badger is programmed in Java, and contains many features which elevate gameplay in both the autonomous and tele-op periods
- Proportional-Integral-Derivative (PID) controllers power the shooter flywheel, keeping the wheels rotating at a constant velocity to decrease variability in each shot, keeping our scoring extremely consistent throughout competition.
    - Without PID controllers, the flywheel, which is commanded to run at certain velocities, becomes dependent on the battery voltage, which does not stay constant throughout a match.
    - Non-constant voltage creates unaccountable variability; since one of our season goals was to maximize consistency, PID controllers were a necessary implementation on the robot.
- Badger is also driven field-oriented as opposed to the traditional robot-oriented drive,
    - This simplifies the controls for our driver, achieving the season goal of robot simplicity.



- Badger utilizes the "Pedro Pathing" program, which increases autonomous accuracy with odometry
    - Pedro Pathing greatly increases match consistency, and ensures reliability, further helping us achieve our season goals
- In future competitions, additional hardware to advance our code will be installed.

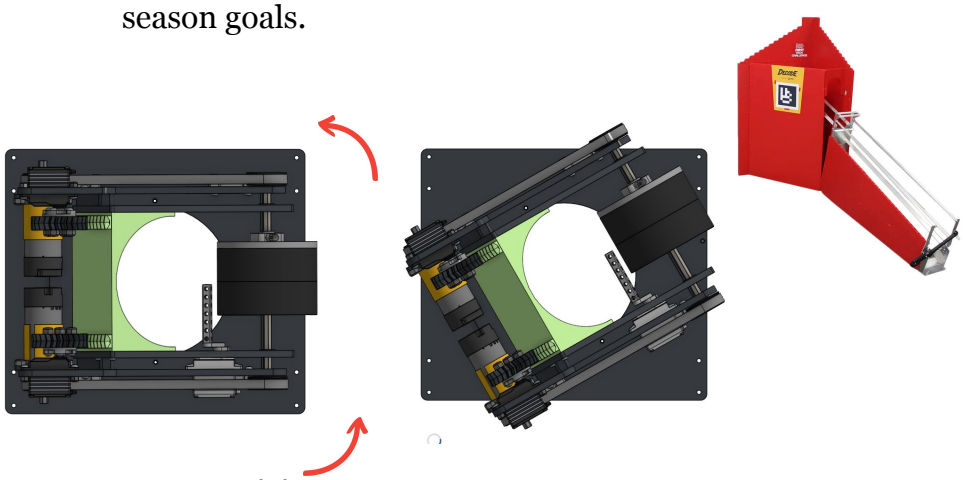


Programming and Feedback

Control

Growth since first qualifier:

- From the previous competition, Badger has been improved through a number of ways:
    1. The previously unused turret was re-wired and programmed with 180 degrees of freedom.
        a. The turret is mounted such that ARTIFACTS exit out of the back, ultimately achieving a pass-through design (the ARTIFACTS *pass through* the robot)
    2. Odometry also tracks the robot position and heading to automatically aim at the goal throughout the match, ensuring greater consistency in every shot, and reducing driver responsibility through code automation.
        a. Robot tracking, as well as turret tracking, is accomplished through various mathematical formulas that combine with hardware information input to control our position and heading.
        b. The turret is also controller with a PID controller to ensure our desired pose of continuous aim at the goal
        c. Badger was initially going to use a Limelight camera to aim at the AprilTags on each goal to aim the turret and position the robot, however, we determined that mathematical formula computation for determining robot and turret heading was more efficient and would be more easily applicable to our robot, maximizing the simplicity of our robot and staying true to our season goals.



Growth since second qualifier:

- After the qualifier in Alamogordo, Badger has improved greatly:
    1. Hood and variable velocity allows us to shoot from almost anywhere on the field
        a. Ability to shoot from different locations and ranges on the field allows for additional versatility and makes us harder to defend.
    2. Light indicator gives feedback to the driver about the robot's mechanisms.
        a. Light indicator displays different colors based on distance to the goal, corresponding with a velocity and hood value for the launcher
        b. A red light is displayed when located in one of the few areas where the robot is unable to shoot from.

Skill Development and Mentors

Think & Connect

Development Plan

- Younger students shadow older students
- We use Onshape CAD Classes
- Use old robots to develop skills such as CAD and Coding

Mentors in Team ENIGMA

How We Find Our Mentors:

- Outreach events
- Parents
- Friends of students or parents
- FIRST Alumni

What our Mentors Taught Us:

Coding

- How to debug errors
- Good coding habits
- How to distinguish between good and bad programs within code
- How to write more dynamic code

Build

- Gave new ideas for Wire Management - Peter & Mark
- Good CAD practices and organization - Gray
- Game Strategy - Peter
- Taught younger members how to create and test prototypes - Felix

Current Enigma Mentors:

Gray

- ENIGMA FTC and FRC Alumni
- CAD and Build Mentor
- Electrical Engineering @ UNM

Peter

- FRC Alumni
- CAD and Build Mentor

Felix

- ENIGMA FTC and FRC Alumni
- Build Mentor
- Mechanical Engineering @ NMTech

Dave

- ENIGMA Parent
- Code Mentor
- Software Engineer

Mark

- FRC Alumni
- Build Mentor
- Robotics & CS @ WPI
- New Mentor

Team Development Plan

Recruiting

- Recruit new members through outreach, school connections, and personal connections
- Share content on social media and run live streams for events to expand program reach
- Operate two teams within the ENIGMA program: ENIGMA 16265 and sister team 33778 Mechanical Error
    - Provide less experienced members with increased roles and hands-on experience
- Mentor newer members through guidance from more experienced team members

Build & Design Development

- Younger members began the season by free-building a robot to learn FTC build and electronics systems, then competed with it in the first two qualifiers
- New members developed CAD and design skills through Onshape training, enabling them to design and build a fully custom robot for the state championship

onshape®

Code Development

- Provide new members with last year's robot to practice coding while the current robot is being built
- Onboard new students by setting them up with the team's coding software and tools
- Assign guided coding projects to help new members build skills and confidence
- Offer mentorship and feedback as students work through their projects

Business/Outreach Development

- Educate team members on our business plan and fundraising strategies
- Create opportunities for students to participate in and lead STEM outreach events
- Involve every team member in contributing to the team portfolio
- Encourage students to network within their communities to set up outreach opportunities
- Build communication and organizational skills through real-world outreach planning

Current Outreach

Reach

We have improved outreach events from last year by bringing robots kids can drive so we are not just talking at them. For the Albuquerque FLL Qualifier we improved by hosting at a better location and had 2 judges panels so competition went faster.

ENIGMA started Rookie FTC 33778 Mechanical ERROR

- Sister team
- Mentor 2-3 times a week
- Share a workshop and tools with them
- Consists of all first or second year FTC members

ENIGMA mentors 9 other 2025/2026 season robotics teams at Desert Ridge Middle School

- Mentored by Co-Captain Callahan
- Estimated 50 kids weekly
- 2nd year mentoring

FTC team 27413 (SPQR Robotics), Rookie FTC 31652 (Gearheads²) & FTC team 21797 Hack City

- Gearheads² - Helped with field set up, code, and mechanical issues through an in person visit, as well as through zoom.
- SPQR - We helped SPQR gain access to a field in order to test their robot, as well as gave them access to tools and parts. Additionally, provide help with robot online.
- Hack City - Helped teach FTC programming to a team of rookie members.

ENIGMA Hosts First Lego League Albuquerque Qualifier

- Organized event, provided food and drinks for the volunteers
- Students, parents, and mentors volunteered to help run the event along with FTC 23794
- Help from FTC 21797 for providing the venue
- Recruited other volunteers to help fill additional roles.
- 3rd year hosting
- Estimated 250 people

ENIGMA @ NASA Space Apps Challenge

- Established a presence at a local annual hackathon
- Created pathways for team sustainability, pipelines for prospective mentors and students alike
- Connected with community programs, and helped expand the STEM presence within Albuquerque and NM as a whole

Goals & STEM Connections

Connect

Season Goals

- Make it to Worlds
- Spread STEAM in New Mexico
- Help to create new FIRST teams and develop current teams

Steps to Reach Goals

- Managed time wisely, continue to make improvements
- Promote STEAM at all outreach events to try and get kids involved in any form of STEAM
- Host FIRST Lego League Qualifier so Albuquerque teams can compete
- Mentor other teams such as FLL team at Desert Ridge and new FTC team-27413 SPQR

Science, Technology, Engineering, and Math Connections

We worked with:

- Matt Williams- Mechanical Engineer

This helped us by:

- Giving us feedback on our robot to help fix errors

Larger Events Completed

- Ran a two-day-long booth at the Kirtland Air Force Base, showcasing FTC robotics and FIRST as an organization, connecting families across NM to FIRST organizations in their communities and neighborhoods.

SMART Goals					
Goal	Specific	Measurable	Achievable	Relevant	Time-Bound
Build Competitive Robot	We as a team need to build a competitive robot through planning, build, and code	Top 100 Offensive Power Ranking in the world according to FTC Scout by performing well with alliances	Our goal is achievable based on past seasons	Increased acknowledgement across the country means more opportunities to learn from world class teams	Reach top 100 OPR by the end of the regional competition
Reach World Competition	We want to receive an invitation to the worldwide FIRST competition from our Regional Competition	We will receive an invitation at the end of Regional Competition	Our goal is achievable based on past seasons performance.	Allows us to learn from world class teams for better improvement next year	Have an invitation by end of State Championship

ENIGMA Business - SWOT ANALYSIS

Sustain

A SWOT Analysis is a strategic way of planning that is designed to help organizations and individuals, to identify internal and external factors that can impact their goals and objectives.
Benefits of a SWOT Analysis:

a. Simplify large amount of data in an easy to visualize way
b. Promotes communication
c. Helps us see different perspectives

Strengths	Weaknesses
• Community-based (frequent/flexible meetings) • Intense student commitment • Team works well together • Very organized • Access to tools and machinery • Not opposed to change • Experienced members	• Lack of engineering connections • Lack of engineering outreach • Spread too thin (Each individual member taking on more than in previous years) • Lack of member sustainability
Opportunities	**Threats**

• Skill & individual growth
• Grow FIRST in NM
• Collaborate more with other teams
• Secure more sponsors
• Volunteer more in the community
• Connect with the engineering community
• Win state competition & place at worlds
	• Loss of students
	  ◦ Prevented by: Allowing everyone to participate in what they want to do
	• Loss of mentors
	  ◦ Prevented by: Always recruiting new mentors and helping mentors feel a part of our family
	• Loss of funding
	  ◦ Prevented by: Keeping good relations with past sponsors, and reaching out to new possible sponsors.
	• Experienced students aging out
	  ◦ Prevented by: Constant recruiting, outreach, and community involvement
	• Injury
	  ◦ Prevented by: Making sure to take all safety precautions such as safety glasses

Planning and Contributions

Sustain

Individual Contributions and Lessons Learned

Code Team (Elliott):
- Worked on theoretical code to be able to code robot faster.
- Developed better coding practices and made high quality code.

Build Team (Luke, Anirudh, Callahan, Gabriel):
- Improved our design process, involving much more prototyping and testing, and shortening time spent designing.
- Worked to improve CAD skills in order to help design a competitive robot.

Managerial Team (Cody, Callahan):
- Created the portfolio, team buttons, as well as other items to give away at competitions.
- Helped with fundraising, and team organization.

As a Team:
- We improved our teamwork and organizational skills throughout the season.
- Set clear goals and expectations for members.

Organizational Plan

Fundraising
- Make budget
- Fundraise $19,620
- Lower spending by being resourceful with parts

Risk Management
- Using Computer Aided Design (CAD) discover mechanical issues before beginning build.
- Have multiple members able to drive the robot, in case main driver isn't able to make an event.
- Make design decisions that allow parts from previous robots to be reused, reduce financial strain.

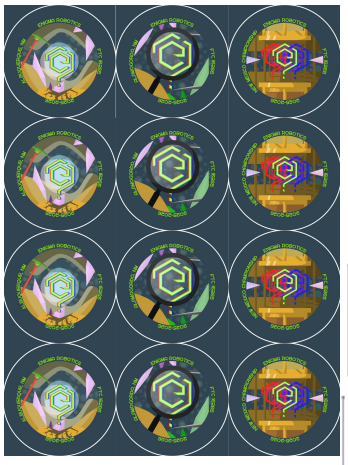
Outreach and Service
- Reach out to our community as much as possible and give demonstrations where ever possible.
- Spread the FIRST ethos of gracious professionalism at outreach events.

Member	Contributions
Luke	Worked on CAD for drivetrain, intake, and shooter. Helped to build robot and was the main mentor with 27413 (SPQR).
Cody	Designed this season's pins, jerseys, and other team identity materials. Modified the robot's decorative elements.
Elliott	Lead the code team, and also mentored developing members of the programming team. Additionally, served the main mentor with 31652(Gearheads^2).
Gabriel	Helped design prototype mechanisms for testing. Worked on the final assembly of the robot.
Anirudh	Helped to create a timeline for robot design, provided robot improvement suggestions, troubleshooted issues, and kept designers on track.
Callahan	Helped others thoroughly think through ideas and helped build the robot. Helped to strategize with alliances at competition and help the drivers design strategies for matches.

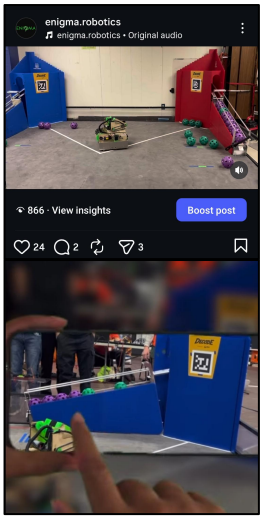
Connections & Marketing

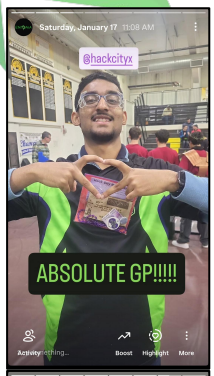
Reach

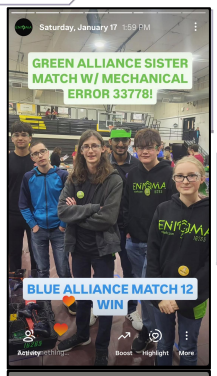
ENIGMA created many marketing items, including buttons for competitions. These materials revolved around the FIRST AGE theme, promoting both team ENIGMA and the FIRST Organization as a whole.



Additionally, ENIGMA has made an effort to increase its social media presence, showing its robot progress and collaborating with other teams, further enhancing its marketing efforts and promoting FIRST beyond competition.







Through helping with New Mexico's FIRST Lego League Explore Fair, and in the process of assisting other teams to develop code, ENIGMA developed its connections with the STEM community in the state while supporting FIRST teams in the state.