99909A

Rising Phoenix

Capital Robotics Club

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Team 99909 A Photo

Get to know 99909A!

Sammy: team co-captain and driver, currently a sophomore at TJHSST

Daniel: team co-captain, currently a senior at TJHSST

Zoe: team manager and driver, currently a sophomore at Langley High School

Justin: team programmer, currently a senior at TJHSST

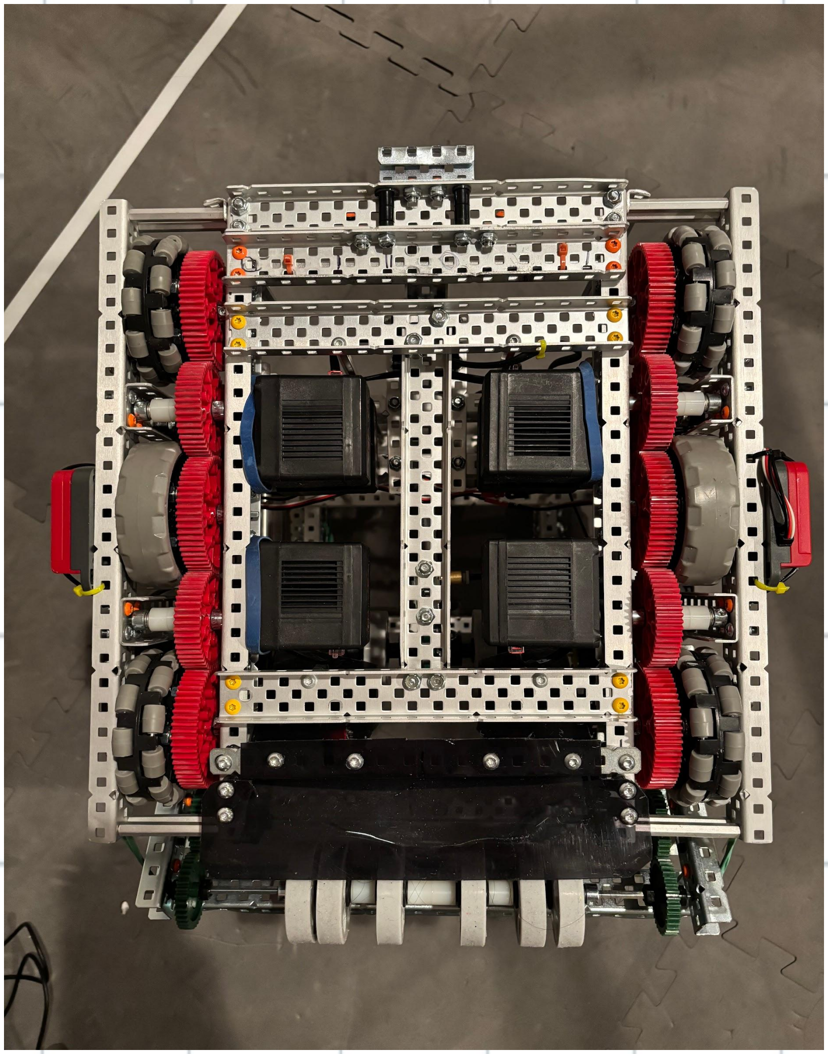
Vaishali: team liaison, currently a sophomore at the Madeira School

Vaishnavi: robot builder, currently a sophomore at the Madeira School

Drivetrain

6-Motor Drivetrain for Speed

- Our six-motor drivetrain is specifically designed for increased speed, aligning the fast-paced demands of this year's game.
- By dedicating many motors to the drivetrain, we gain a strong edge in acceleration, allowing us to reach scoring zones before our competitors and capitalize on every opportunity.



Technical Advantages

- With boosted motor power, our drivetrain produces additional torque, making movement across the field not just faster but smoother, giving us a real edge in agility.
- Our enhanced control lets us maneuver precisely in high-traffic areas, helping us avoid getting pinned or blocked during critical plays.

6-Motor Drivetrain for Speed PT.2

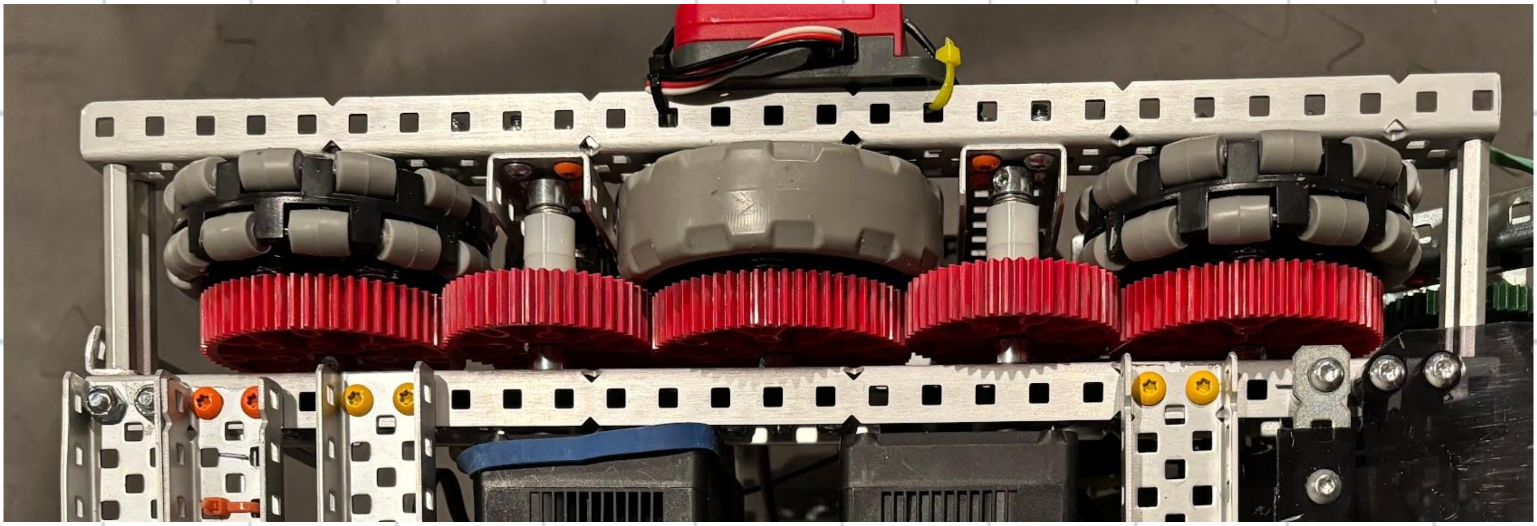
- This setup boosts agility by giving us more control over rapid direction changes and allowing us to respond effectively to in-game situations, always staying fluid and responsive.
- Speed is critical to our strategy because it allows us to cover more ground quickly, maximizing our offensive play possibilities.

Technical Advantages

- Reduced response time keeps us nimble; split-second decisions are crucial for sidestepping obstacles and smoothly navigating around other robots.
- The combination of speed and agility makes our robot highly adaptable, letting us switch seamlessly between offensive and defensive roles as the game demands.

Wheel Choice

- In our drivetrain, we use a combination of two omni-wheels and one traction wheel in the middle
- We want to be able to maneuver and turn well, which is why we have the omni-wheels on the ends
- However, we also need to make sure we have some power in our drivetrain so we do not get pushed around by other robots, which is why we use a traction wheel in the middle where we do not need omni-wheels for ease of movement



Strategy considered

- To maximize drivetrain performance, we assigned six motors, which reduced available power for other subsystems.
- This choice called for careful trade-offs in weight and power distribution, with adjustments to ensure the robot remains stable at high speeds.

Strategy considered Pt.2

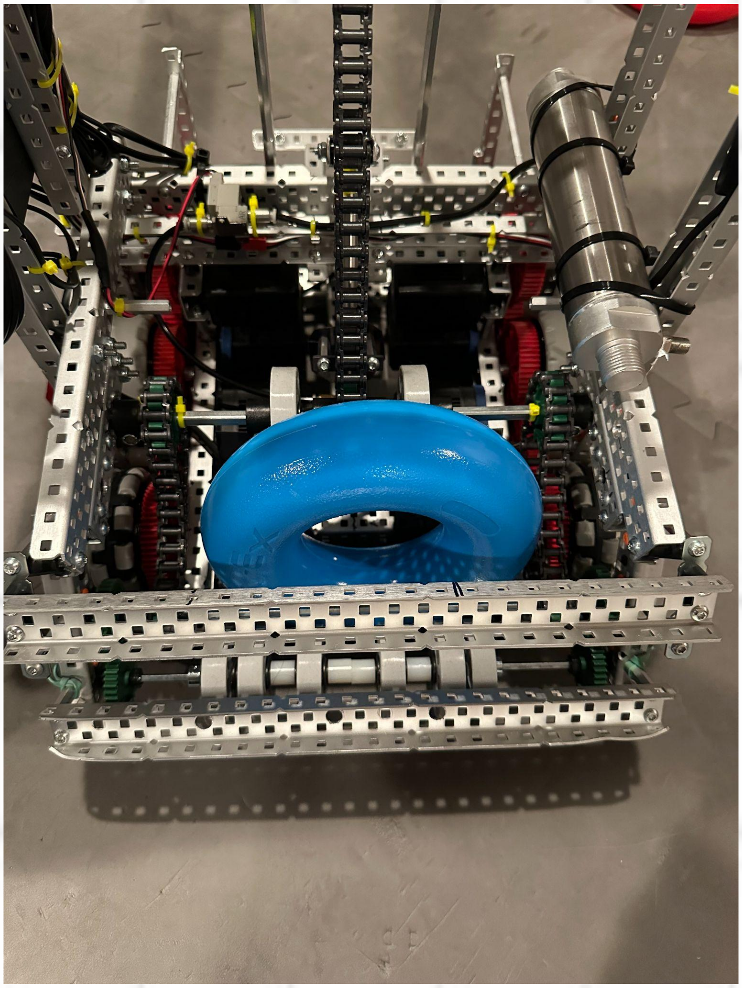
- Focusing on speed led us to streamline certain mechanisms, trading a bit of versatility for pure offensive efficiency.
- These sacrifices were intentional: prioritizing scoring potential over defensive features aligns directly with our strategy for this season, giving us a competitive edge where it matters most.

Ring Collector

Problems Regarding the Ring collector

Ring Persistence and accuracy:

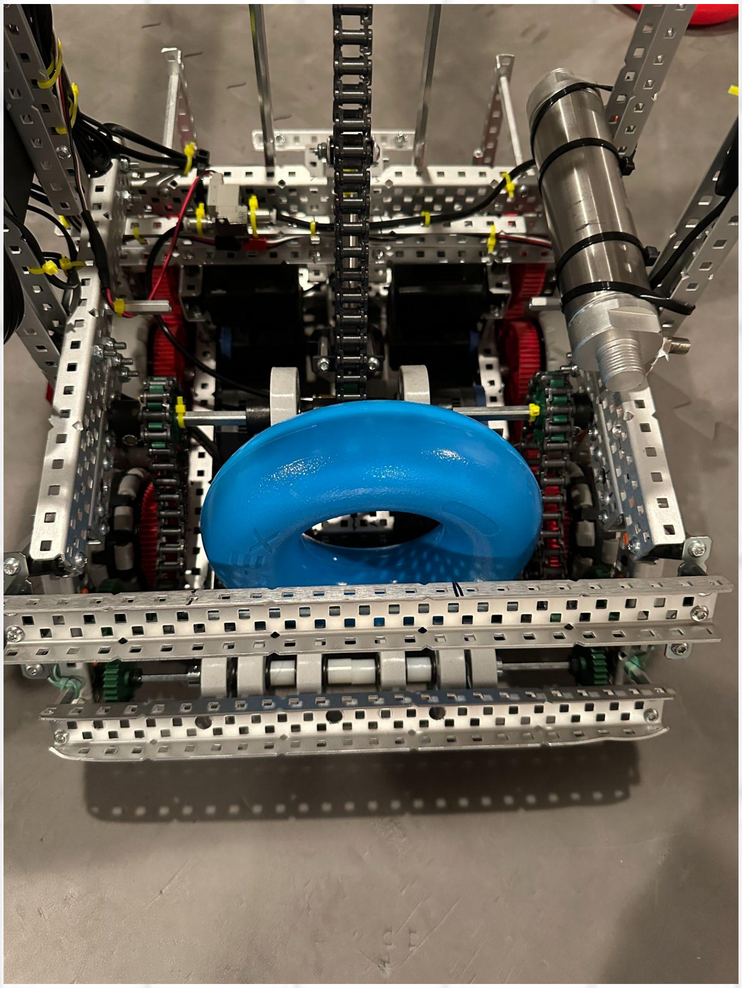
The first and foremost problem that caught our attention while testing the ring collector included it not being able to go up the conveyor belt fully and at a 100% accuracy rate.



Problems Regarding the Ring collector

Ring Persistence and Accuracy:

If the robot were to be driven with this "stutter-10-second-problem", we would be missing another 50 seconds in the entire match, which could cost us multiple points throughout the competition.

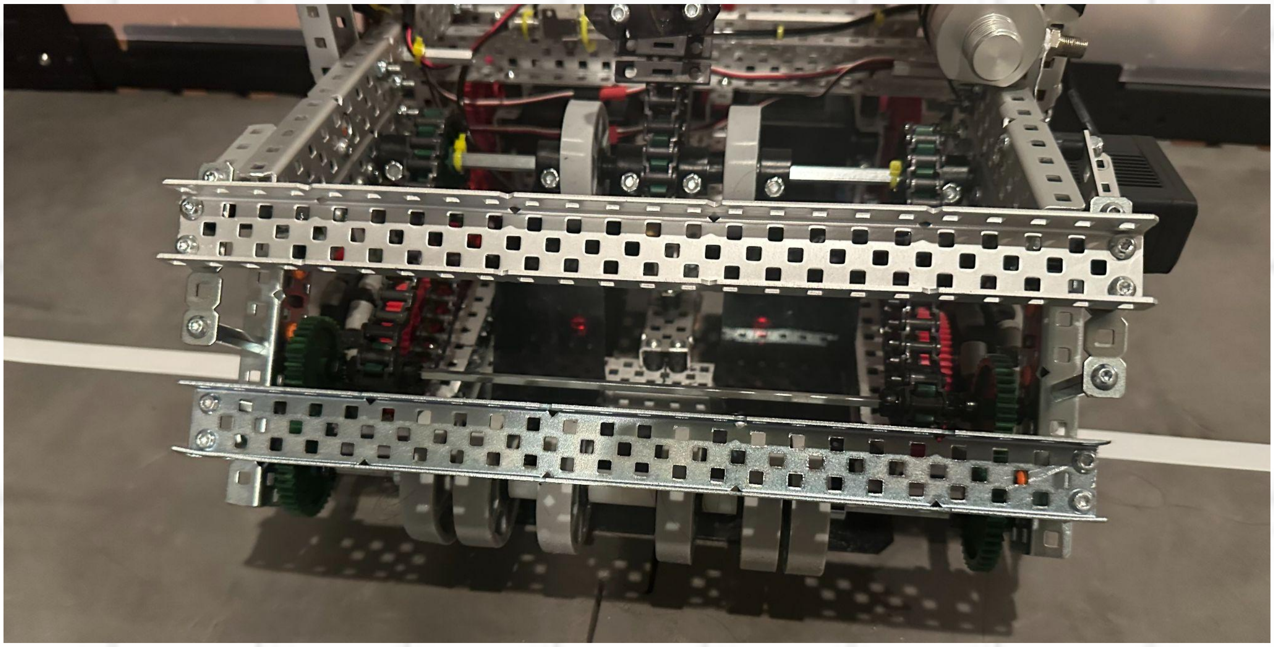


Solutions to Problem #1:

Steel bars at an angle:

After analyzing the problem by filming what was happening in slow motion via iphone, we noticed that the ring did not have enough support in order for the rubber tabs on the conveyor belt to scoop up the rings.

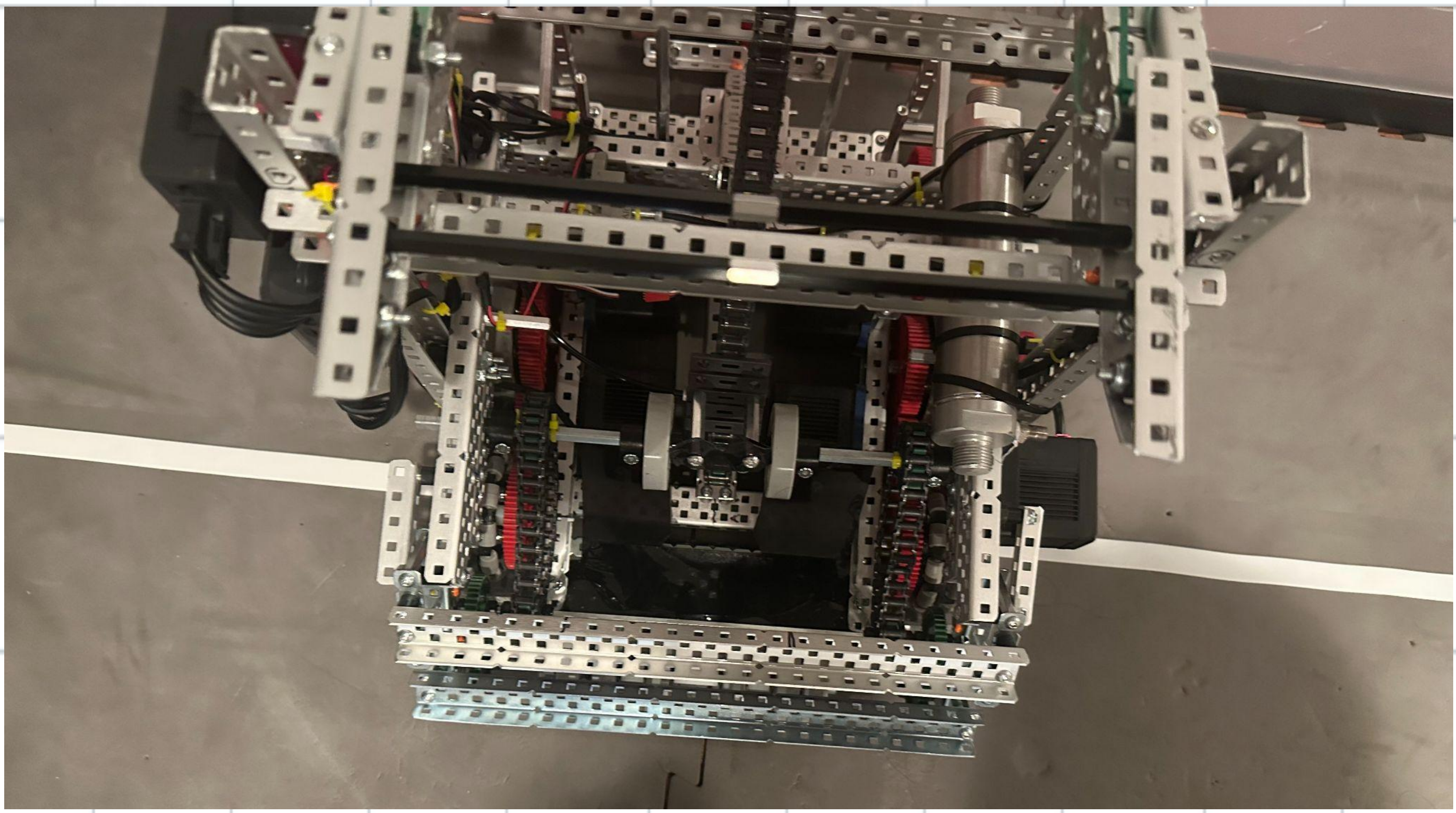
Therefore, our solution was to drill in a steel 2x24 beam at an angle perfect to capture the right amount of space for the rings to get scooped up. This serves as a trapper, so the ring has nowhere else to go, except up the conveyor belt.



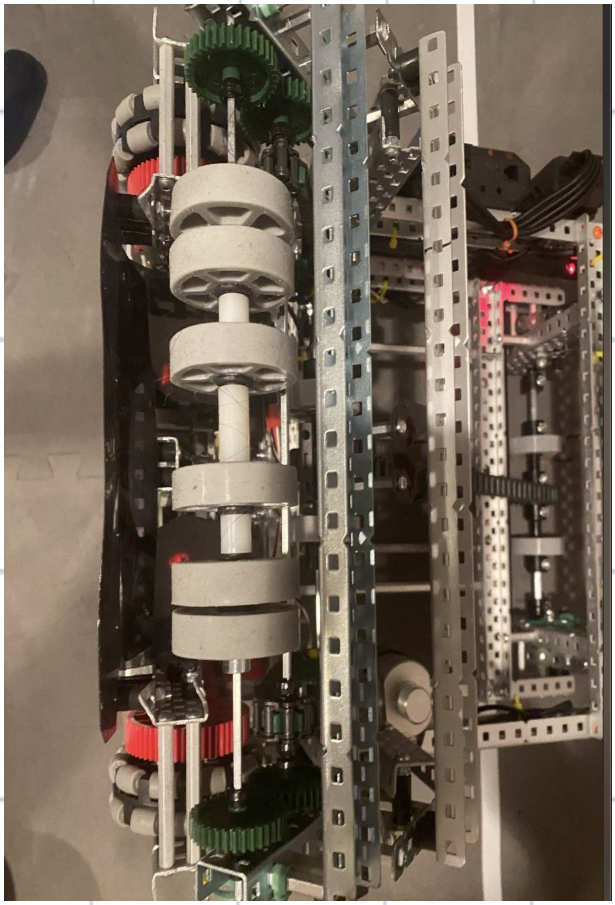
Solutions to Problem #1:

Steel bars at an angle:

We decided to use **steel** instead of regular metal because after using regular metal, we noticed that it bent after a few practice runs. This created an irregularity in our robot, and we wanted it to become as strong as it can be. Steel is much harder to bend, and is heavier, giving more weight support to the robot as needed.



Ring collector

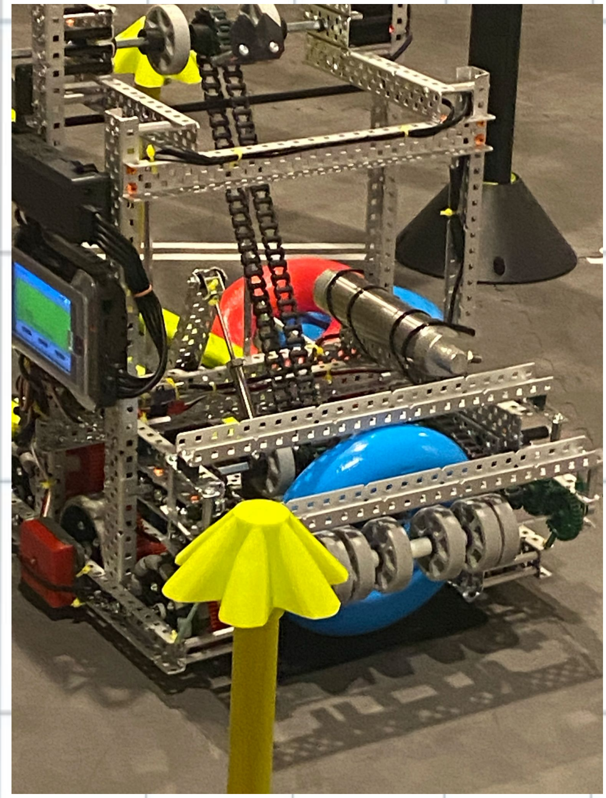


We have roller wheels for the intake of the rings across the field. They are spun and only one ring can be picked up at a time. It is efficient in picking up rings. The speed of the collector is quite fast, and it picks up rings quickly

Ring collector Pt.

A challenge we have run into however, is that the rings sometimes get stuck behind the bar above the collector and are lodged inside.

Occasionally the flappers on the ring deposit mechanism manage to pick the rings up up but they often stay lodged in place until they are removed.

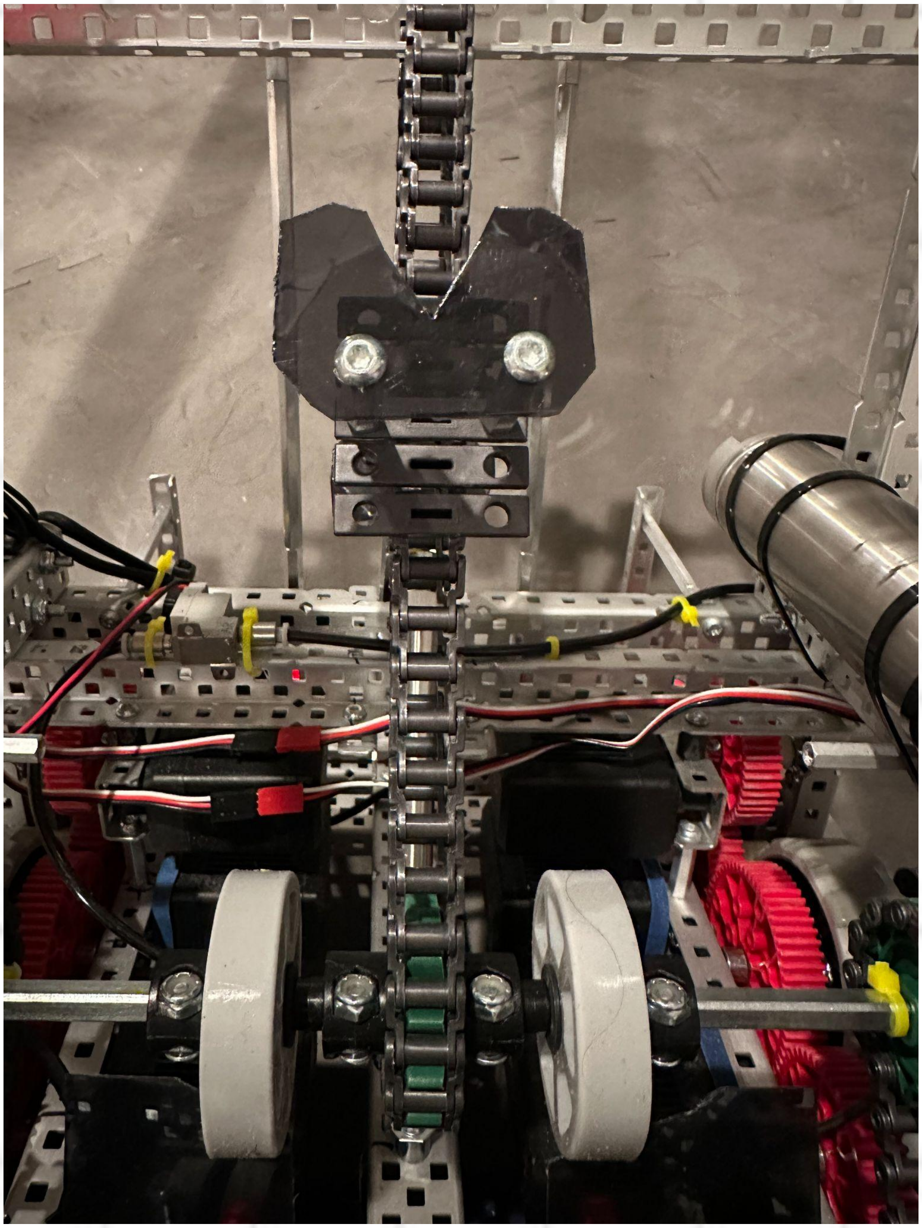


Ring Deposit Mechanism

Ring Deposit Mechanism Overview

The ring deposit mechanism collects and deposits rings efficiently using a conveyor belt system with roller wheels and flappers.

The roller wheels spin to capture one ring at a time, while the flappers installed along the conveyor ensure appropriate alignment and keep the rings secure as they pass through the system.



Ring Deposit Mechanism Overview

- The conveyor belt promptly transports the rings to the deposit area, where they are carefully set for release
- The system's synchronized components are designed for high-speed operation, allowing for smooth, continuous collection and deposition, guaranteeing peak performance throughout our matches

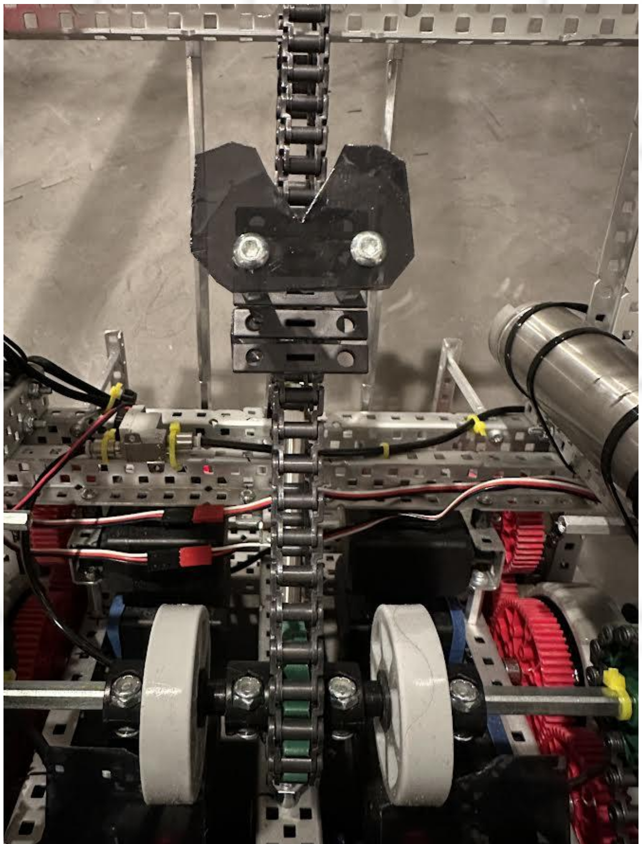
Problems with Ring Deposit Mechanism

- One important concern with the ring deposit method is that the chain often comes loose during operation.
- This interrupts the collection and deposition process, needing constant modifications to bring the system back on track.
- This problem not only slows down the operation, but it also increases wear on the components, which could lead to more serious problems over time.

Chain disconnection that happens often, however we created a solution to bolt screws with nuts to the back of the chains to lock them in place.

Problems with Ring Deposit Mechanism

- Another issue comes from the flappers used to pick up the rings. While they can effectively grab the rings, they sometimes fail to release them properly.
- The rings become stuck in position, resulting in jams that have to be manually cleared.
- This inefficiency in flapper operation disrupts the process and lowers the general dependability of the system.
- The flappers' inability to consistently release the rings can lead to incremental delays in depositing the rings.



Problems with Ring Deposit Mechanism Pt. 2

Occasionally, there is also a disconnect between the stake and deposit mechanisms. When this happens, the rings are stuck in awkward position, usually between the robot and the stake or at the top of the stake. This misalignment makes it difficult for the mechanism to function properly and for the rest of the rings to be deposited smoothly. Removing this blockages requires additional effort and has the potential to be a very serious issue during gameplay, affecting time and efficiency.

Solutions for Ring Deposit Mechanism

We solved the problem of the chain coming loose by altering its position, fastening it, and increasing chain tension. These changes have stabilized the chain, minimizing disruptions and assuring seamless operation.

We improved the flappers' engagement mechanism by optimizing the timing and pressure with which they activate. This guarantees that the flappers consistently and accurately release one ring at a time, preventing clogs and improving deposit reliability. The enhanced control of the flappers has increased overall efficiency and reduced downtime.

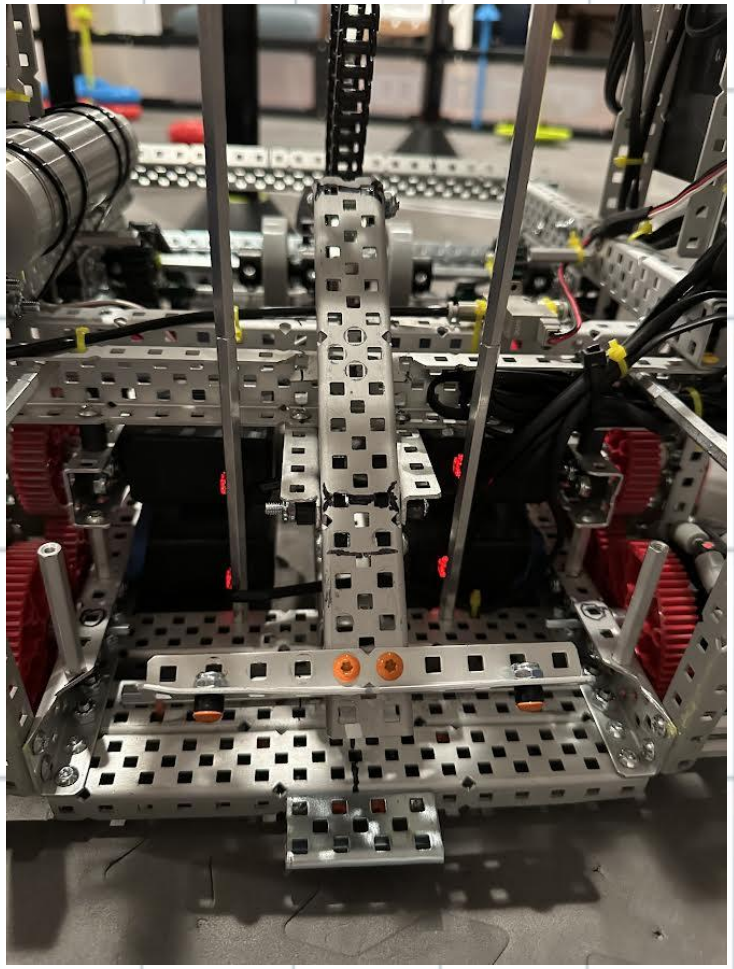
Solutions for Ring Deposit Mechanism Pt.2

To address the issue of rings becoming stuck due to the distance between the stake and the deposit mechanism, we not only modified the conveyor belt speed but also fine-tuned the angle of the stake. This setup encourages a smooth passage of rings into the deposit area by guiding them more precisely. The coordinated of the conveyor belt and stake minimizes jams and ensures smoother deposits, even in changing conditions.

Stake Hook Holder

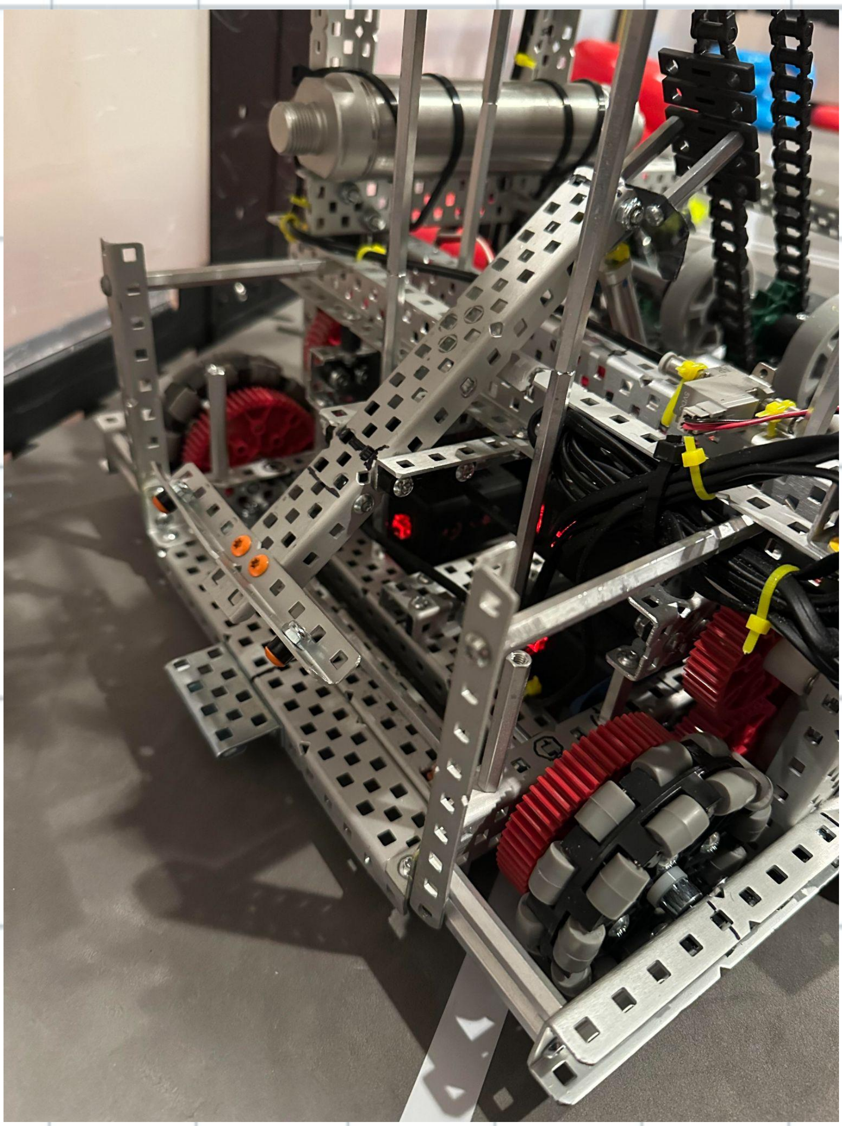
Stake Hook Holder Overview

The stake hook holder is an essential component of the robot, designed to securely latch onto the stake from below. Its main role is to hold the stake at a specific angle, enabling the robot's wheels and other systems to engage with it efficiently and capture the rings. By keeping the stake firmly in place during use, the hook ensures consistent functionality and stability, even during rapid movements and sharp directional changes enabled by the six-motor drivetrain.



Stake Hook Holder Overview

Strategically positioned at the front-bottom of the robot, the stake hook holder is optimized for efficient engagement with the stake. Its angle and location are carefully calibrated to provide a secure hold while avoiding interference with other components. The hook holder fits in smoothly with the robot's overall structure.



Challenges With The Stake Hook Holder

During testing, we encountered some flaws with the stake hook holder that affected its performance and dependability. These issues prompted different solutions to ensure that the robot could perform consistently and successfully during matches.

Stake Instability:

- The stake often fell out of the holder at random and unexpected times, especially during fast spins or when the robot hit bumps on the field.
- This issue led to inconsistent performance and affected the robot's ability to perform its tasks reliably.

Challenges With The Stake Hook Holder PT. 2

Mechanical Alignment challenges:

- The stake hook beam's initial location made it difficult to securely attach the stake.
- Vibrations and quick directional changes caused the stake to move out of position, lowering the robot's working effectiveness.

Structural Weakness in Early Designs:

- Earlier versions of the stake hook holder deformed after continuous usage.
- The bending weakened the holder, weakening its ability to securely latch onto the stake over time.

Our Solutions To The Stake Hook Holder Challenges

To address stake detachment concerns and improve the overall performance of the stake hook holder, we made a couple of crucial design changes. The upgrades attempted to improve the system's robustness, stability, and reliability, so that it could resist the harsh conditions of competitive use.

Our Solutions To The Stake Hook Holder Challenges Pt. 2

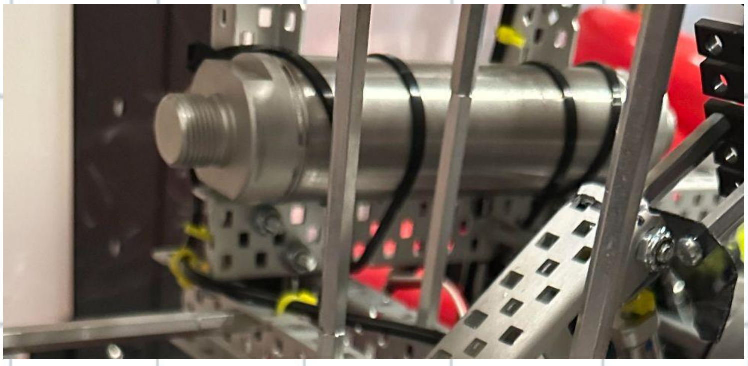
We replaced the original beam with a more durable, stronger material to improve the stake hook holder's strength. This change increases the system's ability to endure the demands of competitive use. Additionally, we adjusted the angle of the stake hook beam to tilt slightly upward, around 5 to 10 degrees. This change leverages gravity to create a steady downward pull on the stake, making sure it remains securely in place. The tilt also reduces the risk of the stake detaching during unexpected movements or vibrations, as the weight of the stake naturally drives it deeper into the holder.

How We Tested These Solutions

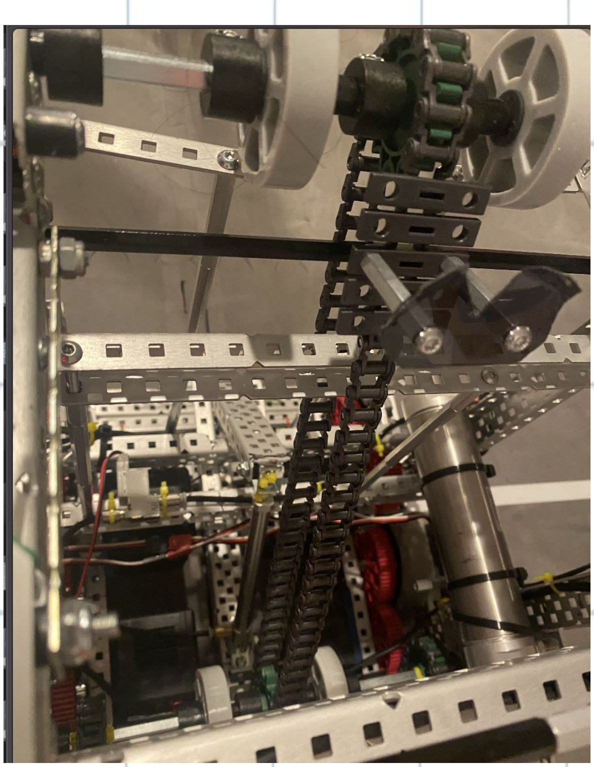
We looked over the changes in our regular tests and practice rounds, including quick directional shifts and impact scenarios. The process called for iterative modifications, with team feedback guiding future improvements. After making the necessary changes, the final solutions were carefully evaluated to guarantee it operated consistently and securely throughout the match, dealing with different stress tests.

Pistons

In crafting the stake hook holder mechanism, we turned to pistons for power, as our motors were already committed to the drivetrain and other key systems. Pistons were the next best choice, though they do demand frequent re-pumping. We're diving into different efficient solutions to keep things running smoothly. The mechanism is snugly secured with zip ties and other fasteners, ensuring it's stable yet easy to maintain. This piston-powered setup is a game-changer for efficient stake collection, boosting our system's overall performance. Furthermore, we'll be testing our re-pumping ideas for efficiency and checking how our attachment method holds up in action during competitions.



Conveyor Belt Mechanism



The conveyor belt mechanism in place is designed to transport rings to the stake efficiently. The system utilizes two flappers on opposite sides of the belt to secure and guide the objects on their way. The spacing of the flappers was optimized to pick another ring up as soon as possible, as we didn't want the conveyor belt to do another full rotation.The conveyor belt rarely experiences misalignments unless tampered with so the risk of uneven movements is low.

Challenge With The conveyor Belt Mechanism

There was an initial issue with the conveyor belt because only one flapper would have to do a full rotation before picking up another ring.

To optimize the time it would take to pick up another ring, we placed a flapper on the exact opposite side of the conveyor belt so as soon as a ring is placed on the stake, another ring will be picked up in least possible time. The position keeps the conveyor belt very centered and even.

Driving Strategy

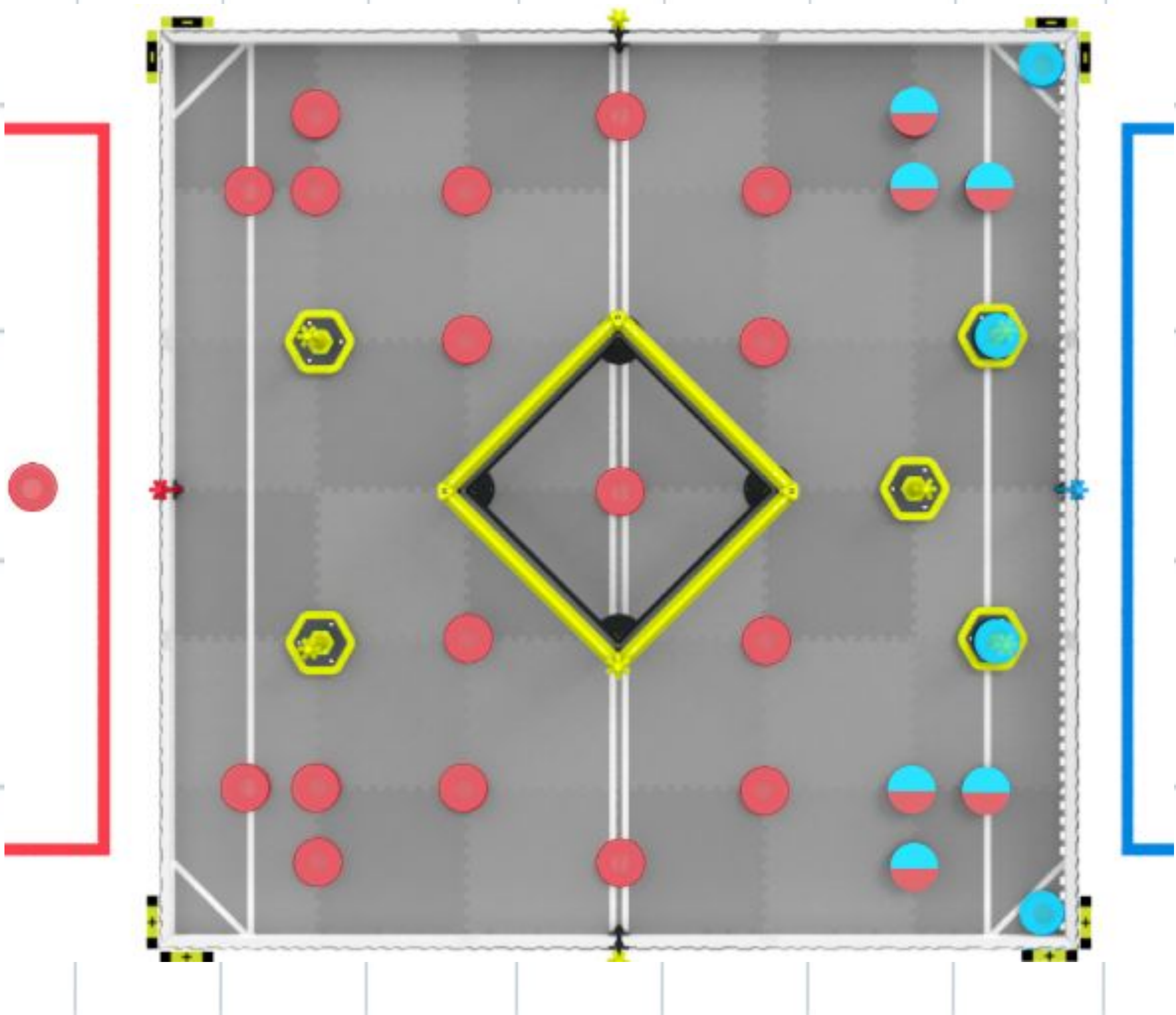
Our Driving Strategy - Part 1 (Skills)

Our driving strategy has to be very concise, time efficient, and able to get as many points as possible in the limited time we have available. Being able to travel with a fast robot is a very efficient factor, however controlling our speed, being able to use it to our advantage, and utilizing while collecting and scoring rings in the last seconds is our specialty.

Our Driving Strategy - Part 2 (Skills)

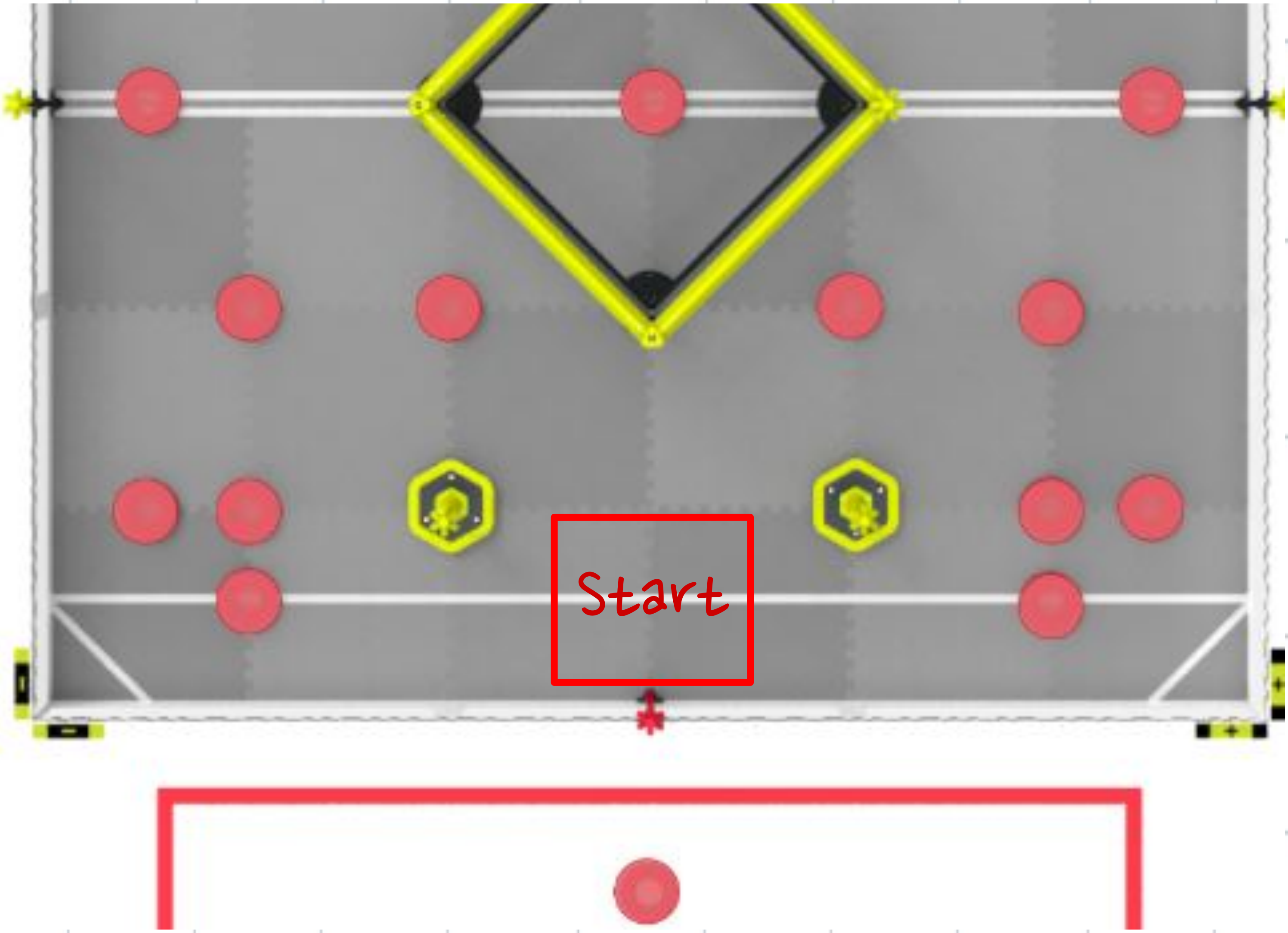
Our Attack:

As we tried to approach the board for the first time, we considered doing the entire board at once, however we noticed a pattern in the ring setup between the left and right sides of the board.



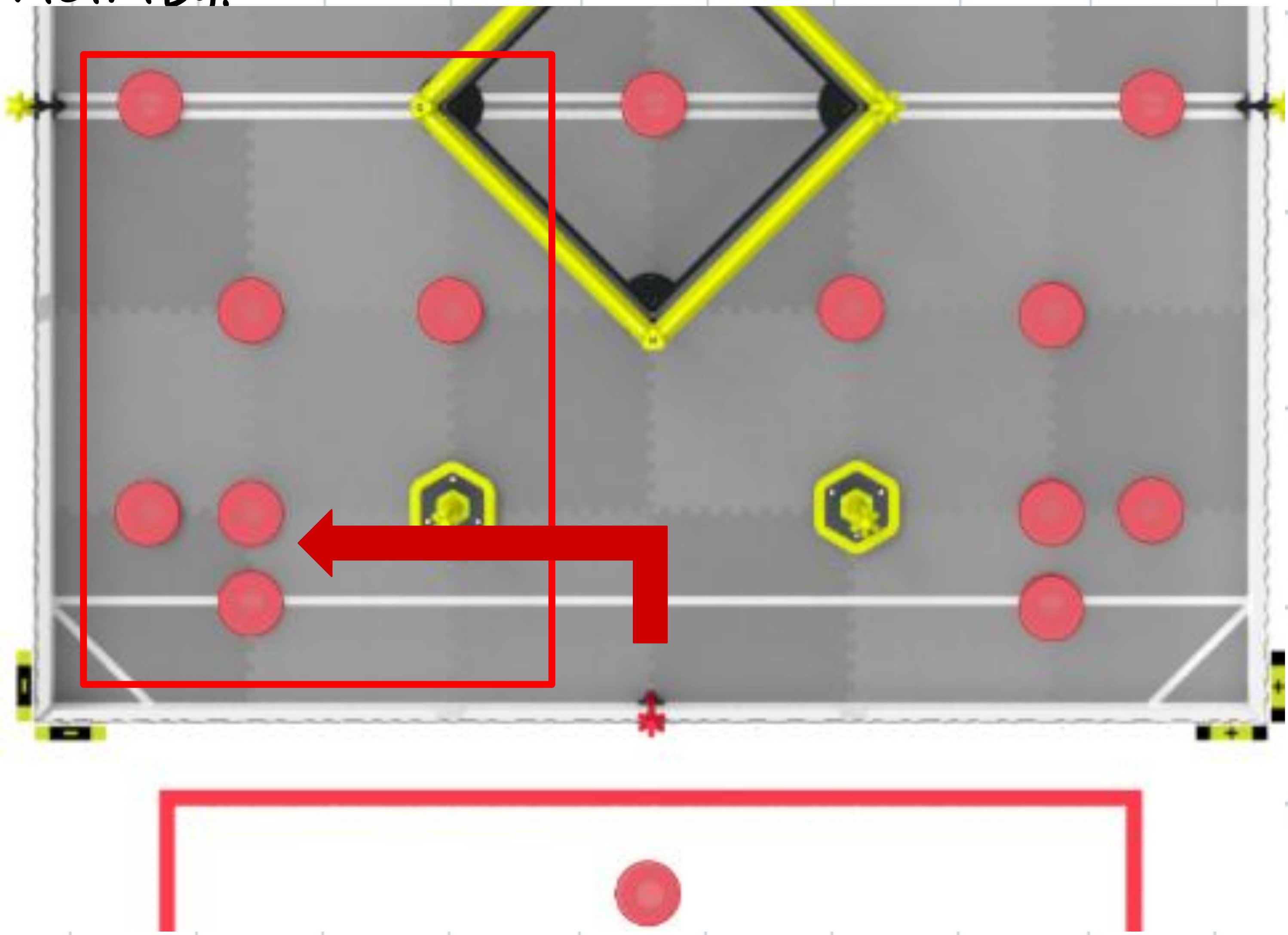
Attack #1

Our first attack consists of splitting the board into two parts, left and right. We want to have our robot start in front of the red stationary stake nearest to the red driving position to score our pre-loaded ring to automatically score points in the first 1 second of the game.



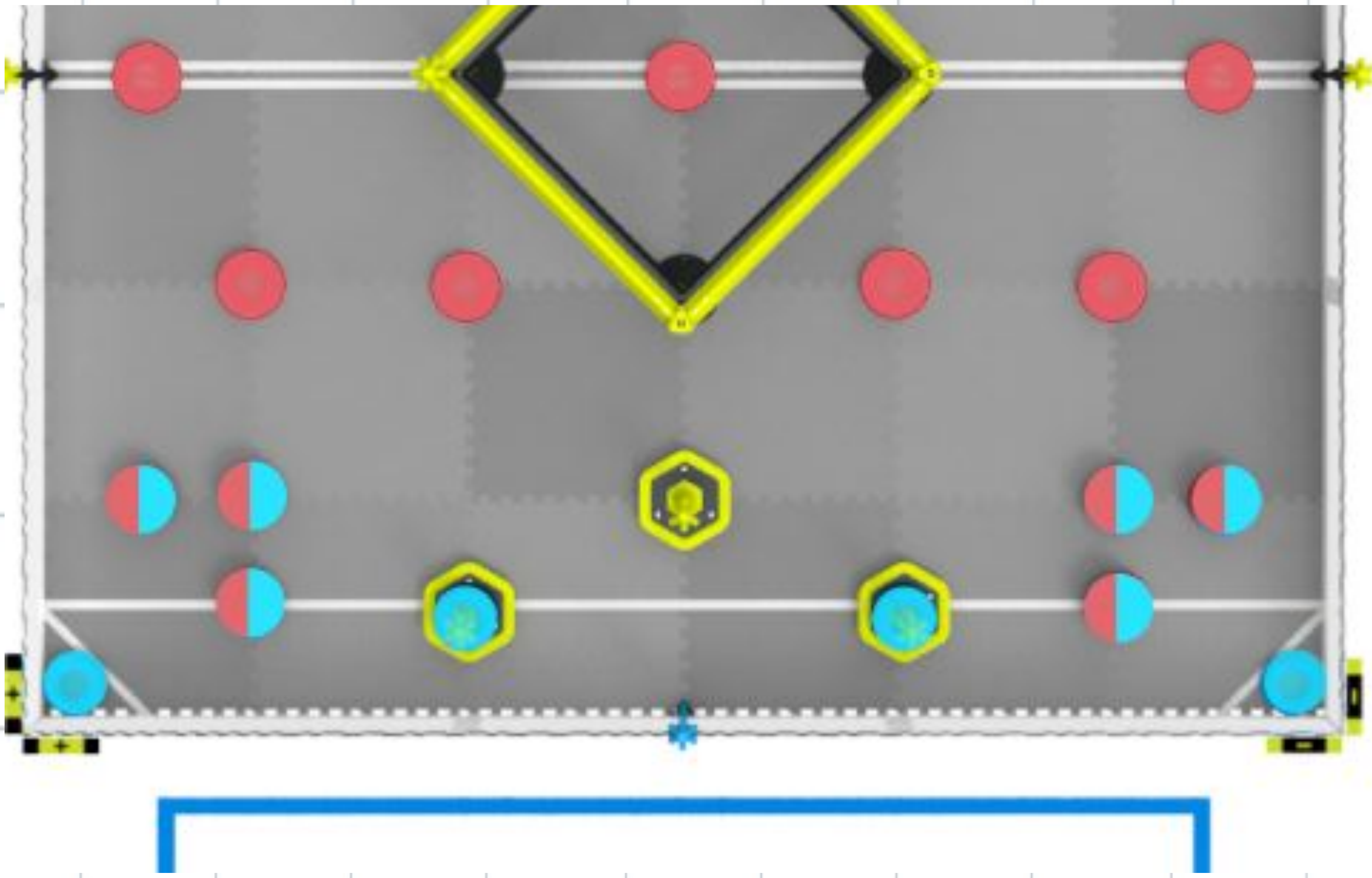
Attack #1

We then proceed to attack the stake on the left, (when viewed from the red drivers point) and collect the 6 rings on the left half of the field. We essentially split up the board into fourths, to easily capture any points we can score in our vicinity.



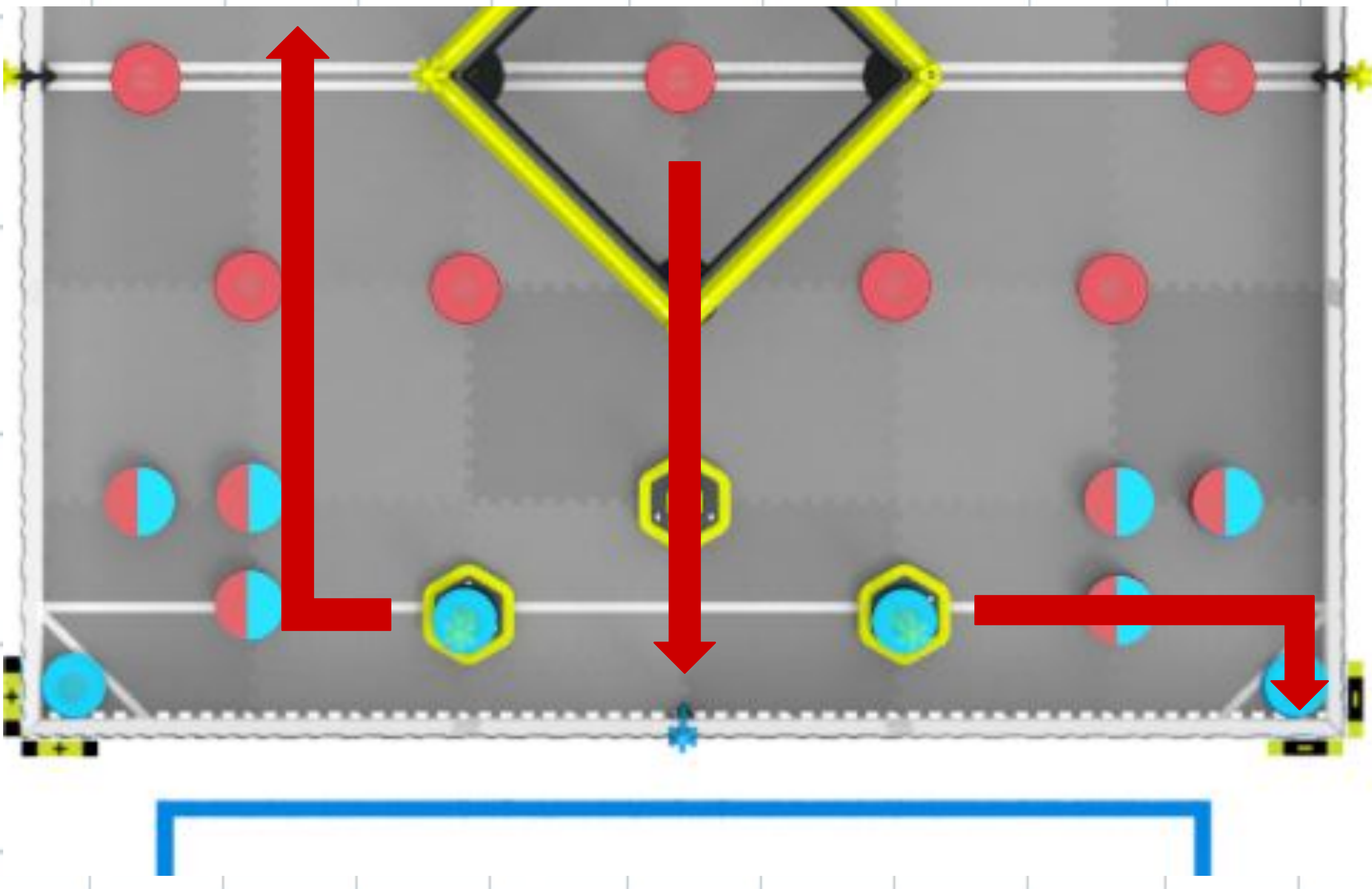
Attack #2

After we managed to score two fully stacked stakes in the two positive corners, we have a remaining estimated amount of 18 seconds.



Attack #2

With these 18 golden seconds, we planned to capture the red ring in the center of the middle tower, place it on the stationary blue stake, and push the two stakes with blue rings into the negative corners to achieve additional points for placement points.



Programming

Odometry

```cpp
void update(std::pair<double, double> deltas) {
    double delta_left = (deltas.first / 360.0) * wheel_circumference;
    double delta_right = (deltas.second / 360.0) * wheel_circumference;

    double delta_theta = (delta_left - delta_right) /
                         (RIGHT_WHEEL_DISTANCE + LEFT_WHEEL_DISTANCE);

    if (delta_theta ≠ 0) {
        // offsets in local coordinate system
        // (delta_dist / delta_theta + wheel distance is equal to radius)
        // TODO: why???

        // c^2 = a^2 + b^2 - 2ab cos(c)
        // c^2 = r^2 + r^2 - 2r^2 cos(c)
        // c^2 = r^2 * (1 + 1 - 2 cos(c))
        // c^2 = 2r^2 * (1 - cos(c))
        // c = sqrt(4r^2) * sqrt((1 - cos(c)) / 2)
        // c = 2r * sin(c / 2)

        // c = 2 * sin(delta_theta / 2) * (delta_dist / delta_theta +
        // wheel_distance)
```

Utilizes two ADI Encoders to keep track of bot position in a local coordinate system. Allows more accurate autonomous movement, bot can correct for errors from external environment. calculated used trig functions.

Competition Reflections

coming soon! Our first competition is pending...

Parts List

This is a complete list of parts used

- Motors: 7
- Piston: 1
- Gas tank: 1
- 2X25 C channel: 12
- Omni-wheels: 4
- Rubber wheels: 2
- 3-Wire Optical Shaft Encoder: 2
- High strength drive shaft: 2
- Drive shaft: 12
- Flex wheels:

Outreach

Outreach History

For more than three years, our team led robotics workshops at Burke Library, encouraging a passion for STEM in the community. In order to give kids from all backgrounds access to hands-on learning experiences, we set out to raise awareness of and education about STEM.

Through these workshops, we sparked creativity and gave students the tools to tackle challenges with confidence. By consistently being there for our community, we established a foundation of trust and inspired a wave of excitement about STEM, helping students see new possibilities for their future.

Why We Started The RISE Foundation

We believe STEM, especially robotics, is an unmatched tool for teaching essential hard and soft skills. It's engaging, fun, and hands-on, offering students the chance to apply critical life skills like communication, teamwork, and problem-solving. Robotics serves as a springboard for shaping future leaders and innovators.

Our personal journey has shown us that STEAM knowledge extends far beyond traditional fields like engineering and science. It plays a vital role in industries such as business, law, healthcare, and beyond. With the RISE Foundation, our mission is not just to educate but to equip young people with the resources they need to thrive while fostering a culture of leadership and lifelong learning.

RISE Foundation

The RISE Foundation, managed by our team, uses robotics as a platform to inspire and empower students, but our mission goes far beyond that. We actively engage the community through monthly or bi-weekly STEAM hours and workshops at Herndon Library, providing consistent opportunities for hands-on learning. Additionally, we've partnered with Sully community center to host robotics "camps" and workshops during the summer and winter, broadening our reach and impact. As we continue to grow, we are committed to expanding these initiatives to serve even more communities.

Our Focus Areas:

- Giving learners the leadership, teamwork, communication, problem-solving, and critical thinking skills that are necessary in any line of work.
- Providing underrepresented youth with meaningful access to STEM opportunities and more by facilitating community-based programs that provide regular support.
- Educating and guiding the upcoming generation of leaders, empowering them to carry forward our mission of community support and innovation.

At its core, the RISE Foundation fosters a cycle of growth: today's students become tomorrow's mentors, helping our community continue to grow and thrive.



VEX IQ



Where We've Worked