99909A

Rising Phoenix

Capital Robotics Club

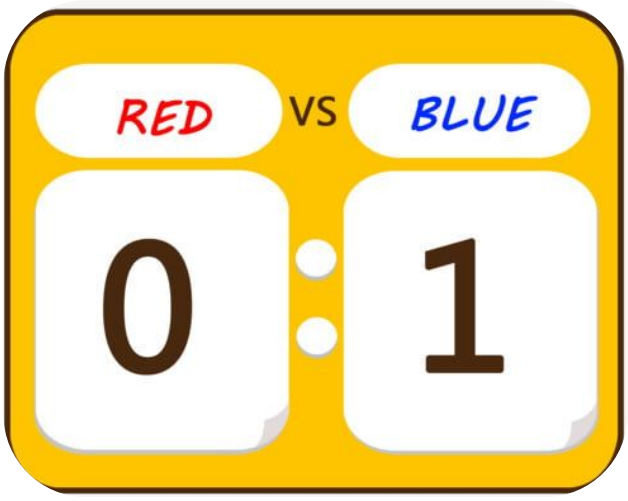
00/00/0000 1 1

VRC Game: Over Under! (Part 1)

Scoring:

- ❏ Each triball in a goal is **5 points**
- ❏ Each triball that made it into the offensive zone is **2 points**
- ❏ Team who scores the most during the autonomous round earns **8 points**

Robot measurements are 18” X 18” X 18”



Name: Zoe Pak

Team 99909A - Rising Phoenix

About Our Team

Zoe - Hello! My name is Zoe Pak, and I am a 9th grader at Langley high school. Some of my hobbies include playing basketball, piano, and reading in my freetime.

Sammy - Hi! My name is Sammy and I am currently a freshman at TJHSST. I enjoy math, programming, chess, and art.

Vaishnavi - Hi! My name is Vaishnavi Alapati and I’m a 9th grader at The Madeira School. Some of my hobbies are playing tennis, piano, and drawing.

Vaishali - Hi, my name is Vaishali Alapati and I’m in the ninth grade. I enjoy painting, cooking, playing tennis, trying to learn new languages, and listening to true crime, history, and educational podcasts.

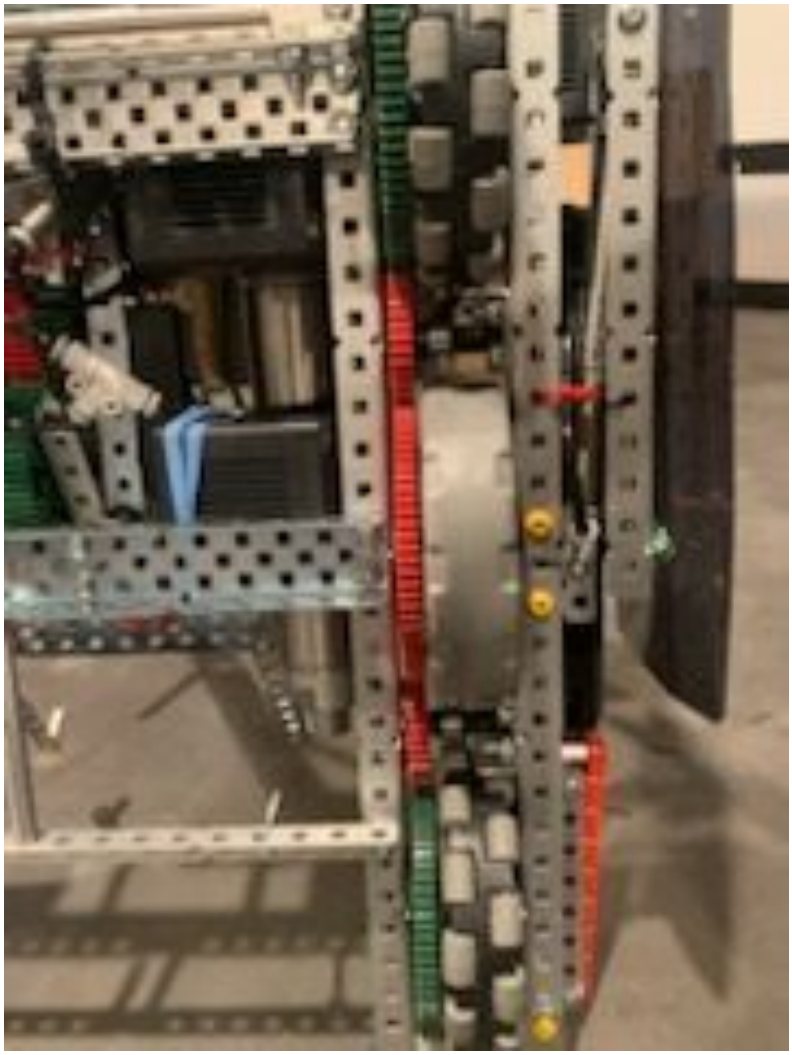
Justin - Hello! My name is Justin Lee and i'm an 11th grader currently attending TJHSST. I have been programming for five years, in particular with Python and C++. My hobbies include weight lifting and programming.

Cristina - Hello! I am Cristina, a senior at Langley High School. This is my third year on 9909A. I like playing guitar, reading memoirs, and learning new skills (I learned to crochet a few weeks ago).

Daniel - Hi, my name is Daniel Wu and I am currently a junior at TJ. I have been on the team for four years. My hobbies are robotics, swimming, and Boy Scouts.

Drivetrain

- 4 motor drivetrain
- Six wheels
- Large gear ratio for faster movement
- Middle wheel is more rubbery in order to get over middle bar
- Green Gearset to balance both speed and torque.



Name: Justin Lee

RETRACTABLE WINGS

The wings will be able to extend out through the pistons.

- Gussets were used to secure the wing to the side of the robot.
- One approach is to use a collar around the piston and a standoff to connect it to the robot.
- Try to use a locking mechanism that is connected by a rubber band to the robot and piston.
    - This part would connect to the russet
    - We could create a catch to protect the rubber band when the wings push inwards

Name: Vaishnavi

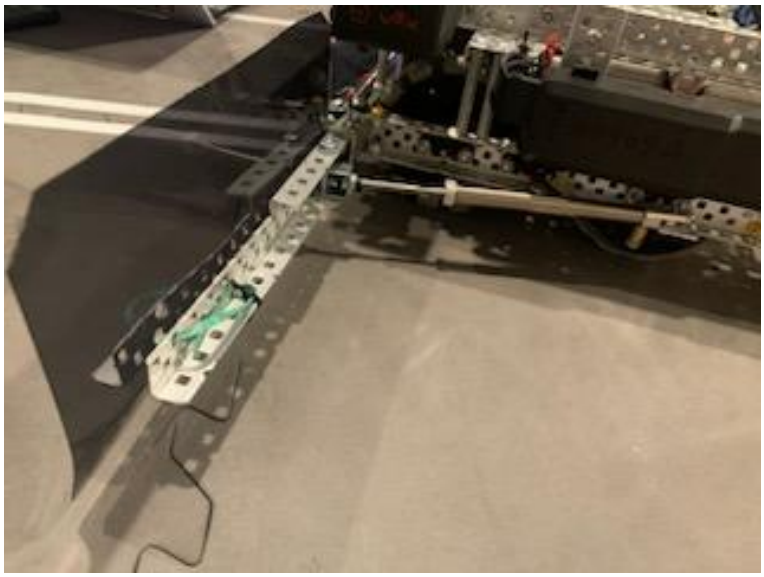
RETRACTABLE WINGS PT.2

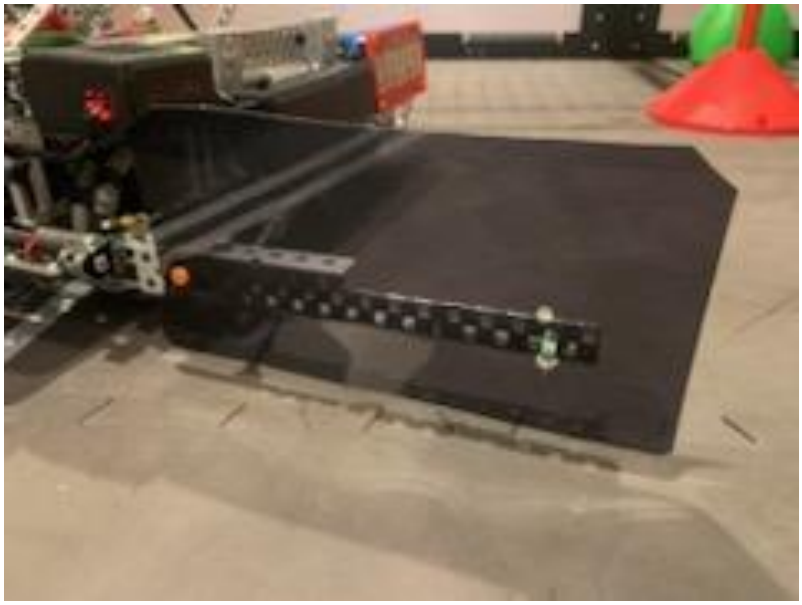
Problems:

- Pumping the pistons enough
- Using enough air pressure in order to “lock” the pistons in place
- Have some type of flexible plastic to easily fit under the goal and adjust to the robot

Solutions:

- Have a certain person on the team that pumps the air pressure/checks it regularly
- Make sure the air pressure is at 100.0 in order to have a secure locking system
- Use the black plastic to have a strong structure, while protecting the robot from incoming triballs





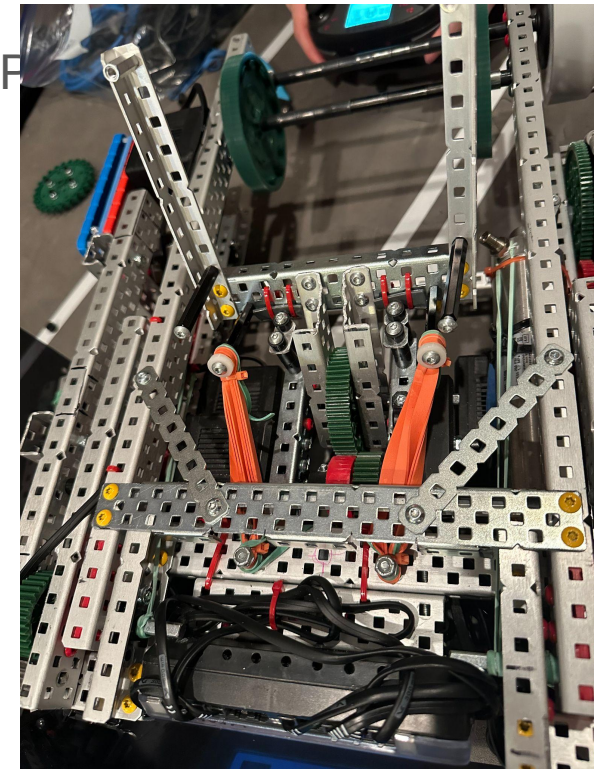
Name: Zoe Pak

Catapult

Catapult Intro!

Goals for our robot:

- Be able to find a certain size in order to allow the catapult to have a “Snug” fit
- Find the exact amount of rubber bands in order to have a good amount of power
- Be able to have a wide shooting range and be able to adjust to different places on the board



Problems/challenges:

- Finding the right amount of rubber bands
- Finding the right angle for the triballs to be launched
- Have fast hands and practice for game speed during a match!

Name: Zoe Pak

CATAPULT V1

Goals:

- Be able to find a certain size in order to allow the catapult to have a “Snug” fit and for the robot to fit under the scoring zone
- Find the exact amount of rubber bands in order to have a good amount of power
- Be able to have a wide shooting range and be able to adjust to different places on the board

Description:

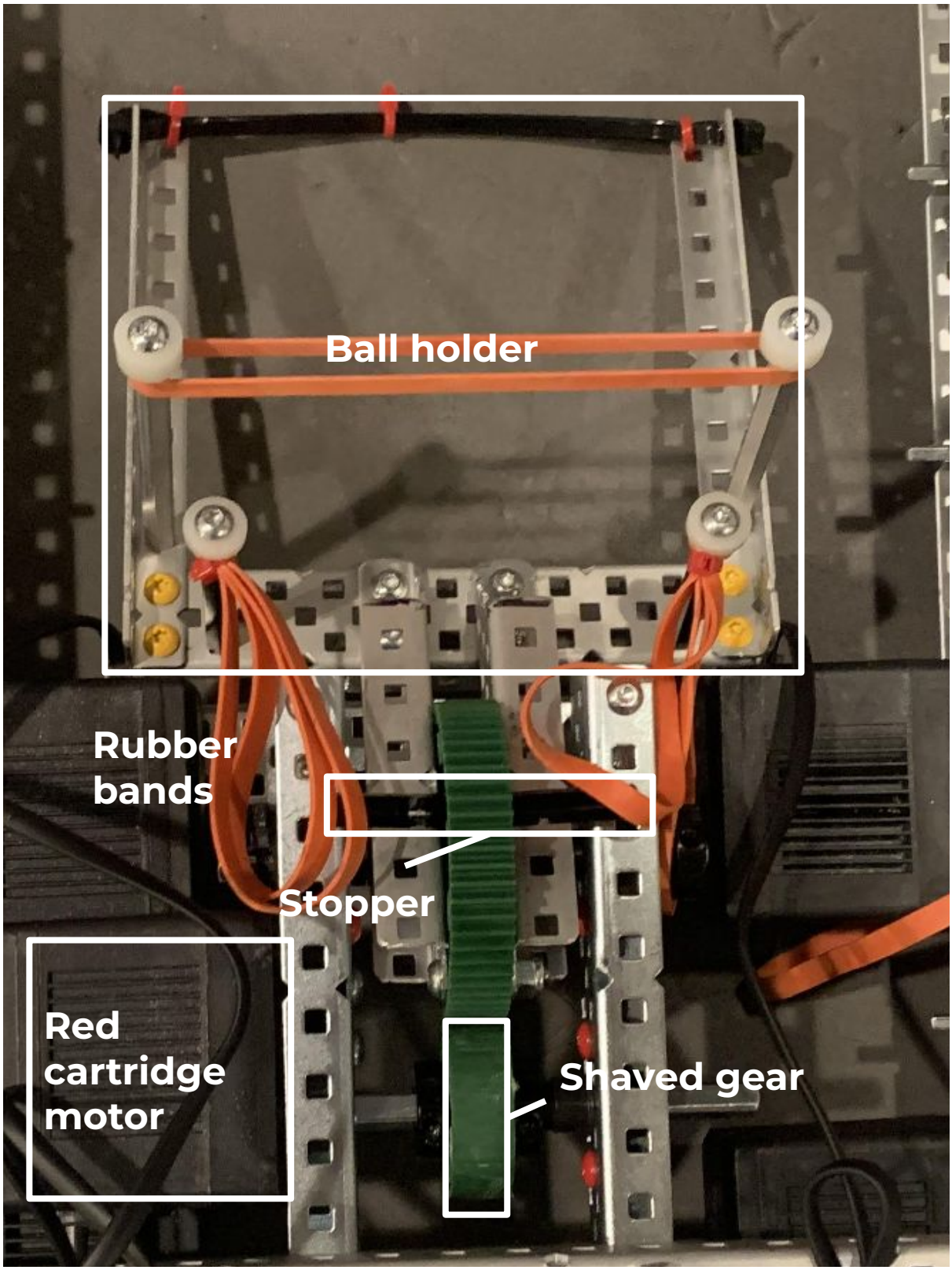
- Small catapult powered by rubber bands
- Cranked using a shaved off gear
- System is powered with a red cartridge motor

Problem:

- Does not launch ball at desired angle
- The stopper bends because of too much stress
- Ball sometimes falls out of catapult

Name: Daniel Wu

CATAPULT V1



Name: Daniel Wu

CATAPULT V2 (Current)

Goals:

- Fix the problems from the previous version of the catapult
  - Launch at higher velocity
  - Adjust launching angle

Modifications:

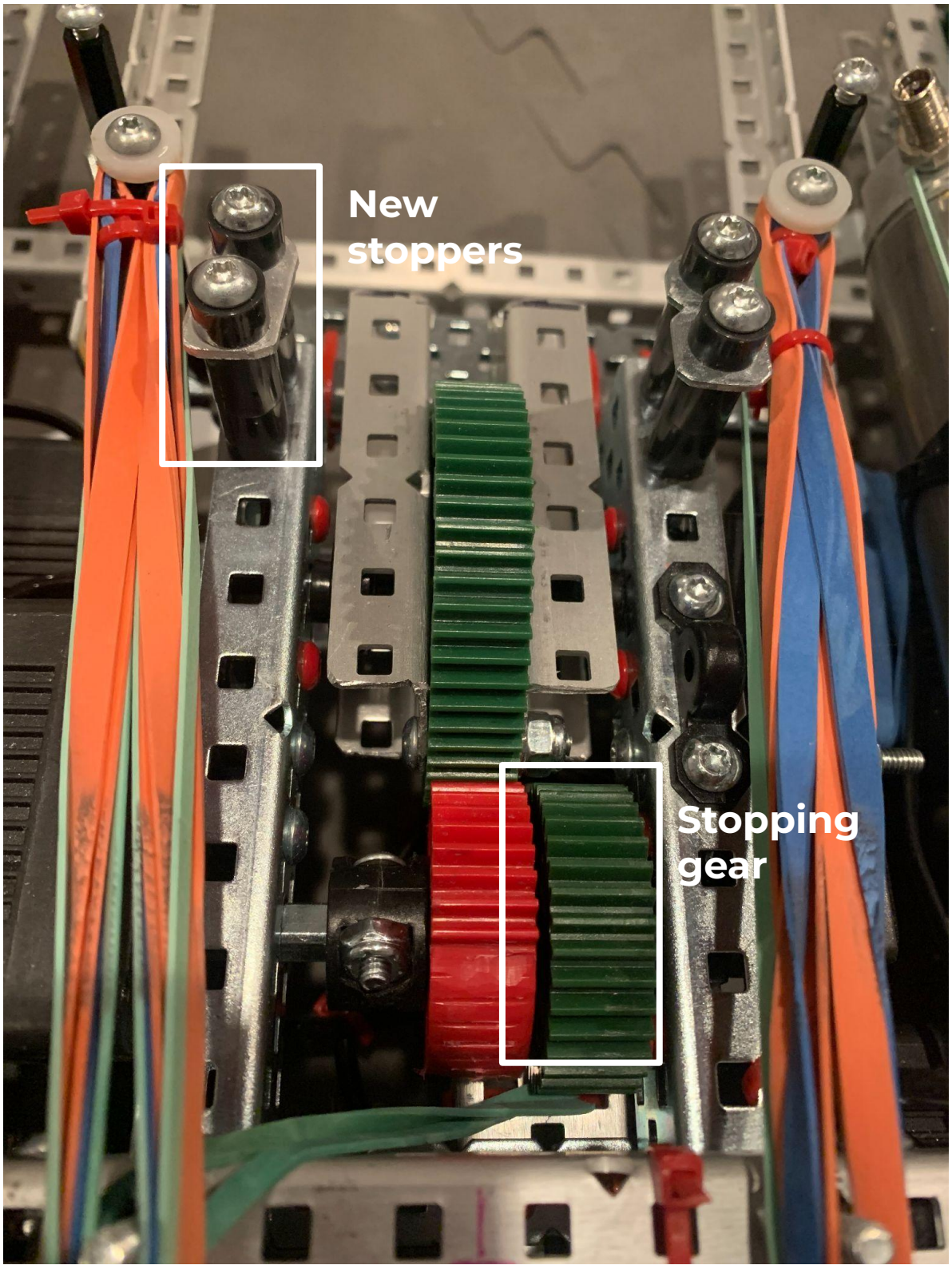
- Changed the stopping mechanism from a standoff on the gear to standoffs on the side so they don't bend
- Remade the shaved gear so it had more teeth and could turn more before releasing
- Added a stopping gear

Problem:

- Ball holder isn't completely reliable
- Ball needs to be placed in exact position to be launched all the way

Name: Daniel Wu

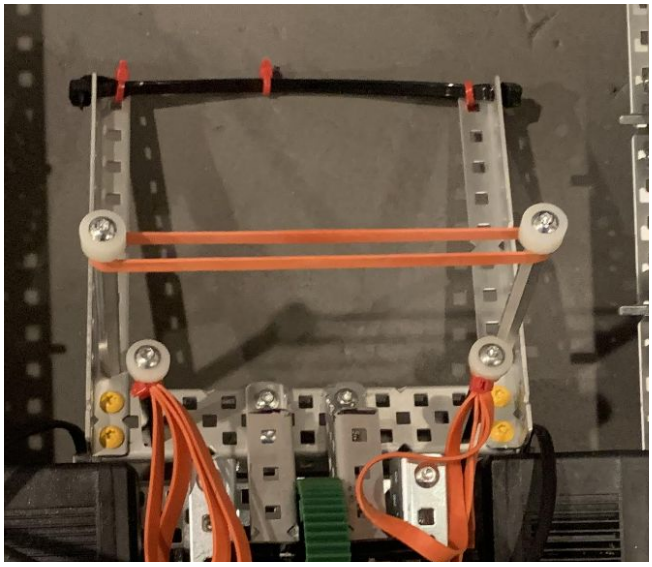
CATAPULT V2 (Current)

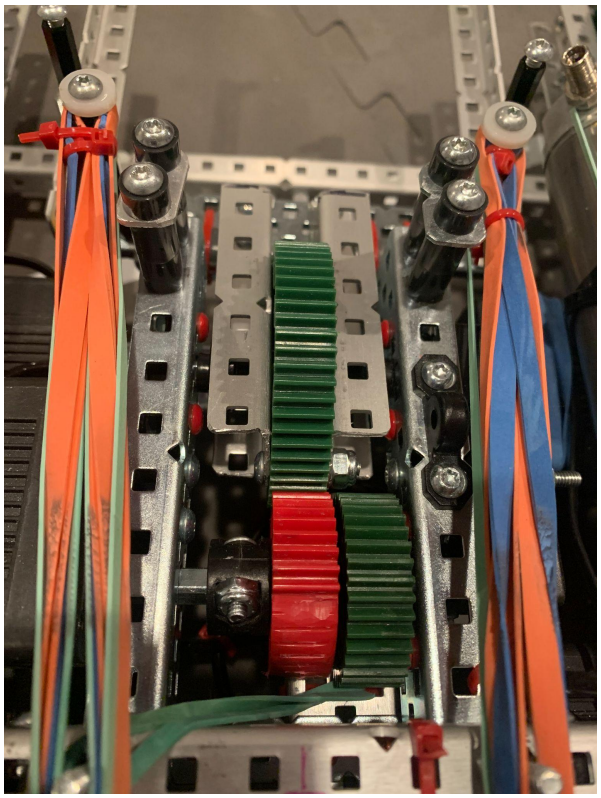


Name: Daniel Wu

INEFFICIENCY OF THE CATAPULT

The catapult shot triballs inefficiently and with very little precision. Ultimately, the objective was to have as many triballs cross the bar as possible. This objective was not being met by the catapult in the manner that we had hoped. For the triballs to be shot correctly, they needed to be loaded in a very specific method. This took time to load because the placement need to be very precise and exact. There was no guarantee that a sufficient number of triballs would cross the bar because it was inconsistent.

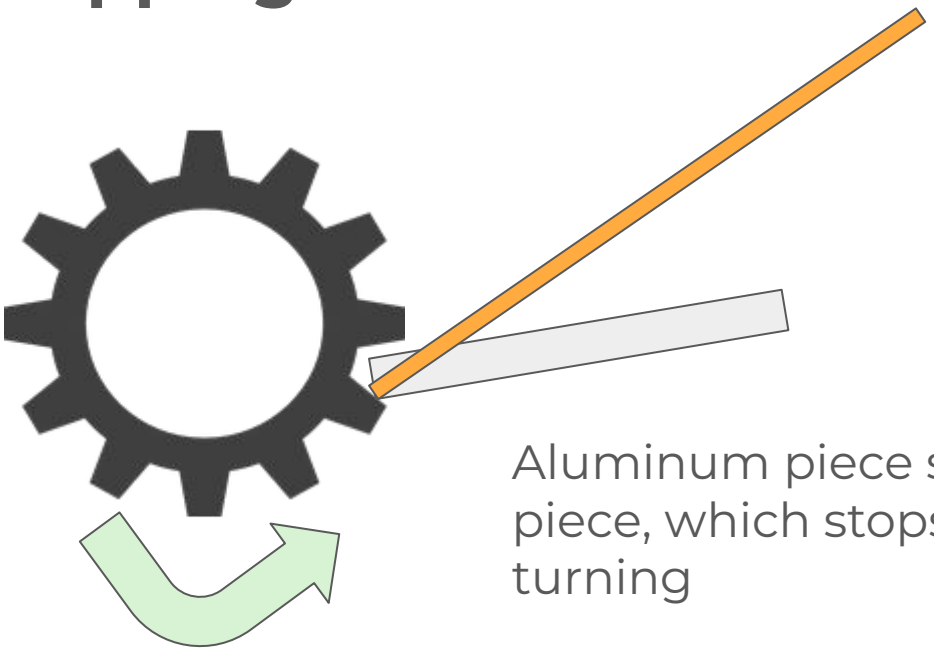




Name: Vaishnavi Alapati

CATAPULT V2 (Current)

Stopping Gear



Aluminum piece stopped by a piece, which stops gear from turning

Gear has tendency to turn to the right

Purpose:

Without stopping gear, motor has to hold in place, using a lot of power and motor might overheat

With stopping gear, motor won't overheat and does not have to run to hold the catapult in place

Name: Daniel Wu

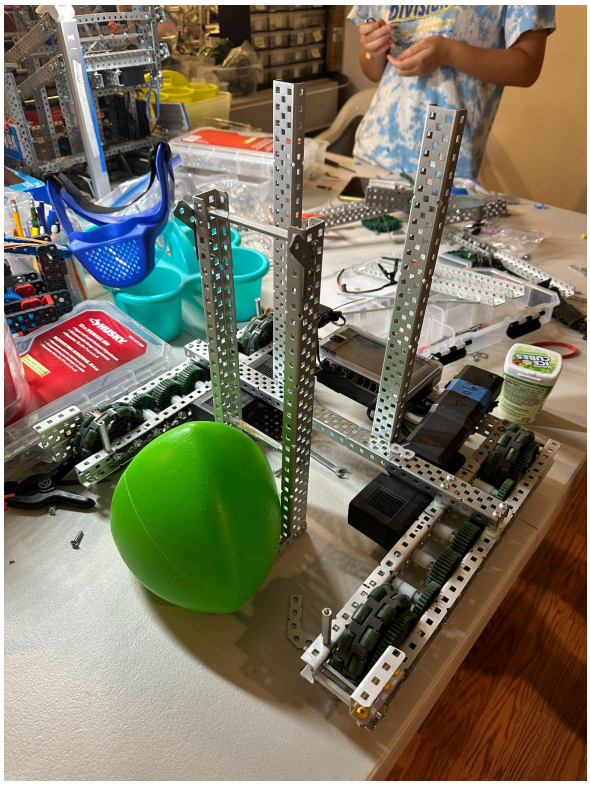
Side wings/Other mechanisms

Kicker Mechanism

Goal for the kicker mechanism:

- Be able to kick across the field into a reliable spot
- Have a good time limit
  - Allow the kicker to reset every time we kick a triball into the desired location
- Make sure the kicker does not exceed the height limit of 18 inches

Notes from Meet!

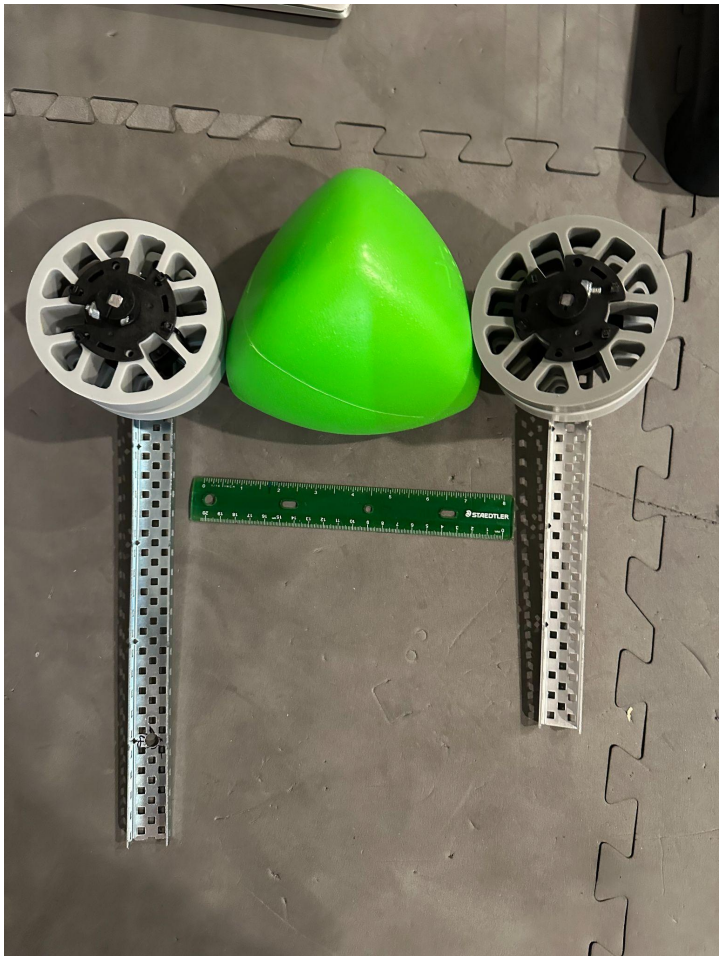


Name: Zoe Pak

Flywheel

Problems

- Having such a heavy mechanism in order to shoot
- Not reliable since the flywheel would have to be at a certain angle for it to work
- Goes against the current of going up while hanging



Potential Solutions:

- Using thinner wheels but a stronger motor
- Could use another motor in order to help angle the flywheel like a tank machine (Not very reliable)

Name: Zoe Pak

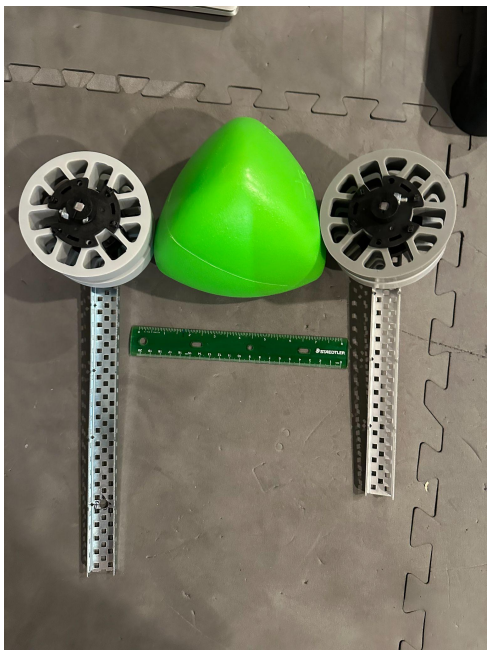
Flywheel vs **Catapult**

PROS

- Can shoot triballs with good precision
- Has the potential to shoot triballs over enemy robot blockers/nets

CONS

- Very slow at shooting triballs (compared to other methods)
- Hard to load balls into catapult, needs to be precise



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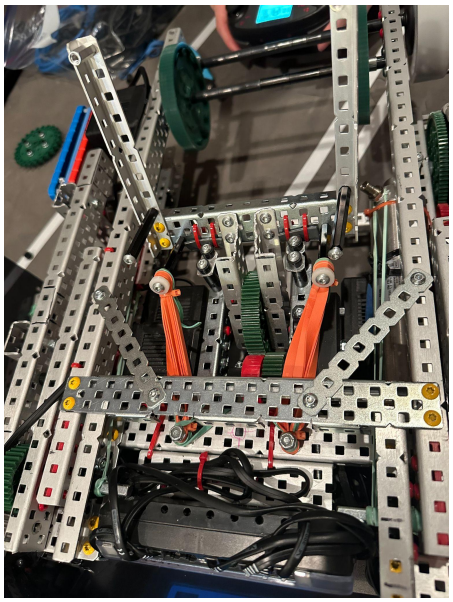


Name: Daniel Wu

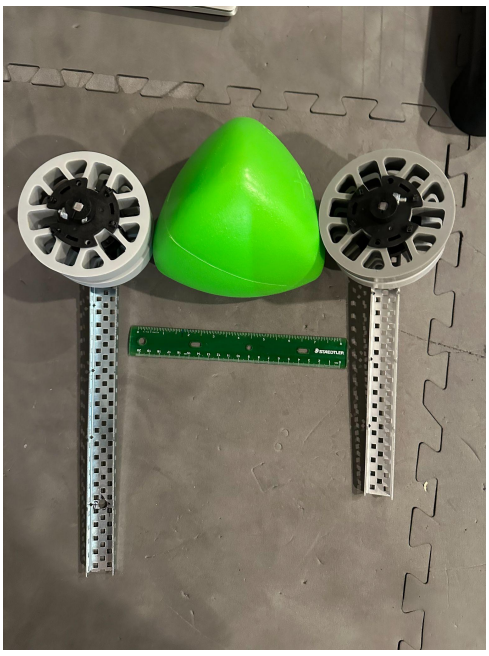
Flywheel vs Catapult

PROS

- Can shoot triballs really fast
- Does not need to be accurate when placing balls on the flywheel

CONS

- Has very low precision in terms of where the ball lands
- Much less balls make it over the bar



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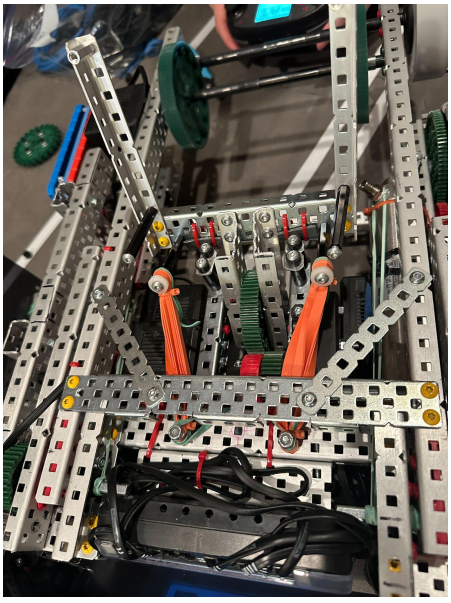


Name: Daniel Wu

Spin Wheel vs Catapult

Pros

- Much faster than both the flywheel and catapult
- Easier to put onto the wheel
  - If you want to be precise, it takes longer to get the right position
- The triballs shoot further than on the catapult

Cons

- Very inconsistent
- Often, too powerful
  - Many triballs land on top of the net resulting in no points
- The wheel often dips when triballs are dropped onto it
  - This makes it hard to consistently drop good triballs

Name: Sammy Li

Spin Wheel vs **Catapult**

Pro

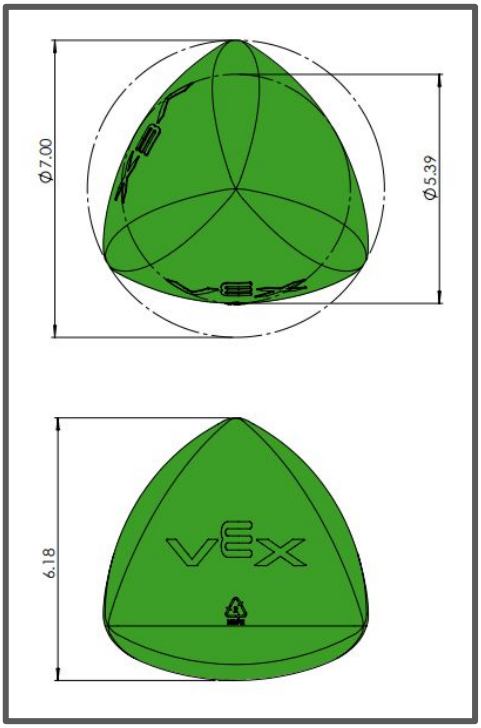
- Very consistent in shooting the triballs at one place
  - In skills, this is useful when pushing the triballs in
- Easier to place triballs onto it
  - One of the triball points is facing forwards

Cons

- Slower than the spin wheel
  - Shoots at around 1 triball per second
- Easy to block in matches
  - The catapult is placed low which makes it easy for opponents to block

Name: Sammy Li

Triball Feeding



Although they can launch triballs really far, catapults need more reset time between shots. The ball feeding action is impacted with this slower reset time. We can concentrate on upgrading the flywheel wheels' grip and speed to guarantee reliable ball intake and spread.

A flywheel can supply a steady stream of balls during triball feeding, facilitating more efficient and smoother loading into the robot's shooting mechanism. Maintaining a high rate of shots while accurately identifying targets is easier with this stability. It operates far more quickly than catapults, and by consistently placing the triballs on their flat side, you can optimize the flywheels' precision. Triballs create greater contact with the wheel surface when loaded with their flat side up against the flywheel wheels, ensuring a cleaner transfer and more secure grip. Triballs are less likely to slip or roll off the flywheel during acceleration because of this alignment, which also improves shooting accuracy and trajectory consistency. However, because of the rapid speed, we can't focus on increasing the accuracy for every triball.

Name: Vaishali Alapati

Pistons

What are Pistons?

A piston is a mechanism that is powered by air pressure causing it to expand and contract. For the team's purposes, we are using a piston to take less space, and allow us to use our motors for another component of the robot.

How they Work:

Pistons are powered through air pressure and expanding gas. In a silver cylinder connected to the mechanism, there is compressed air allowing a 'valve' to open and close depending on when we want the piston to open and close

What are we using them for?

These pistons will be used for the side wings to decrease our opponent's points during a competition. We also decided to use them for for the convenience of the driver and programmer to have more space on the field.

Name: Zoe Pak

Implementing Pistons

Problem:

- Finding enough room for the pistons to fit in the robot
- Having convenience for replacing or fixing during a competition
- Figuring out how to connect the pistons to freely extend on command

Solution:

- Moving the connecting beam between the left and right sides of the drivetrain to create more space
- Having a collapsible mechanism that folds inward
  - This can help create more space for convenience
- Testing to see if the piston will fit on the inside or outside of the beam

Pros:

- Pistons will allow convenience for the driver during a match
- Allows us to use one more motor
  - Perhaps for the climbing mechanism

Cons:

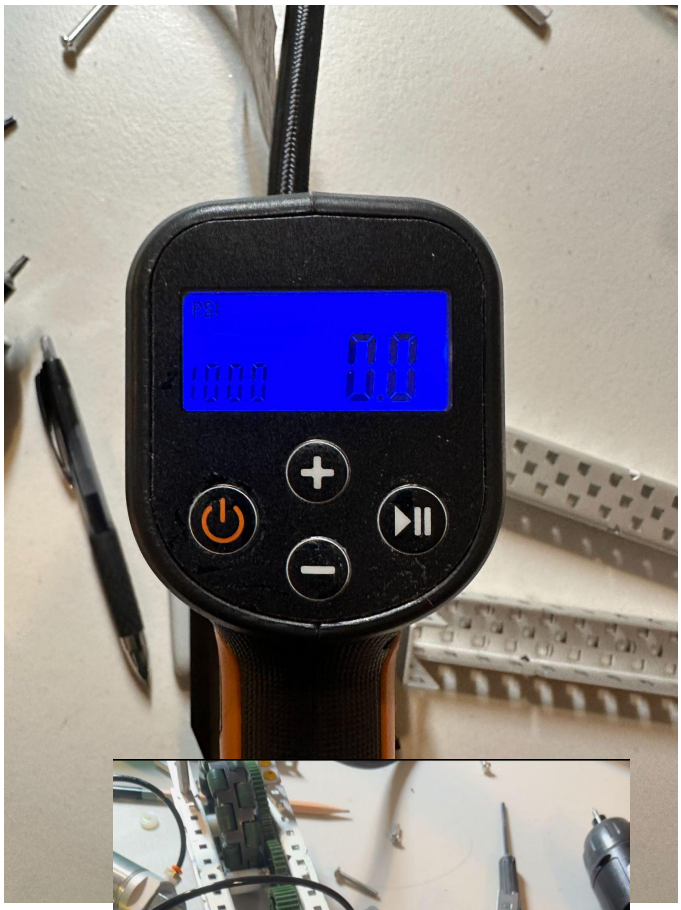
- Amount of space needed to use the pistons may be an issue
- The piston may fail during a competition if not checked
  - Motors may be more reliable in this case

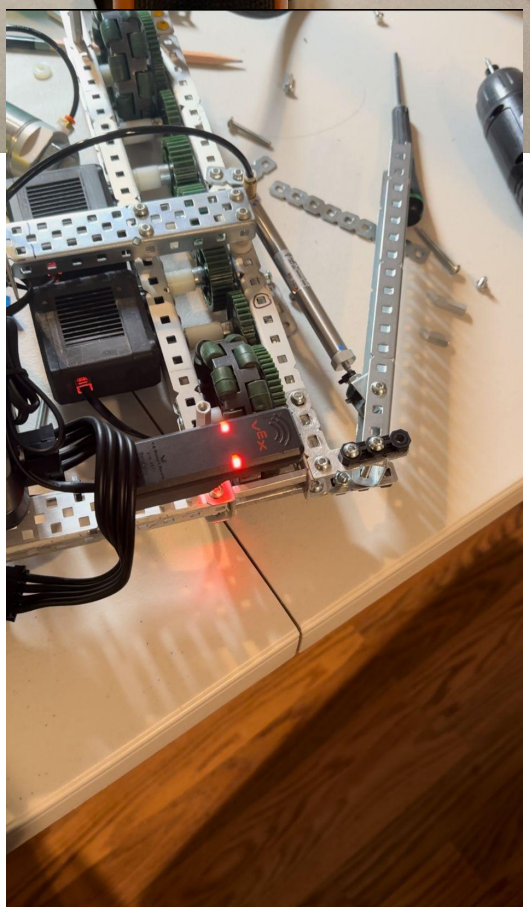
Name: Zoe Pak

Pistons Problems

Problems:

- Pistons retracting too easily
- Being too flexible
- Placing the piston in a place where the wings can still fold inward





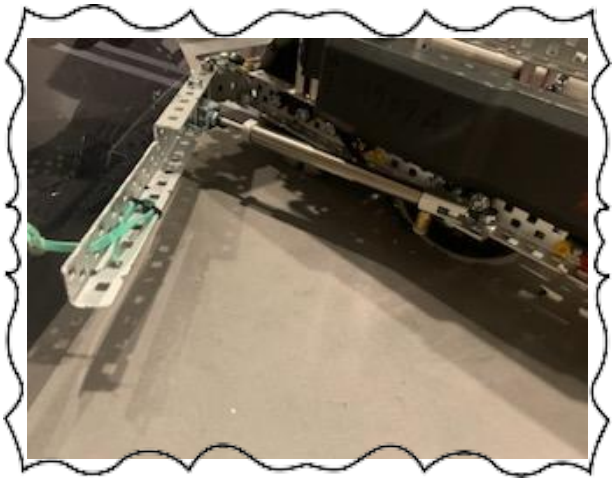
Solutions:

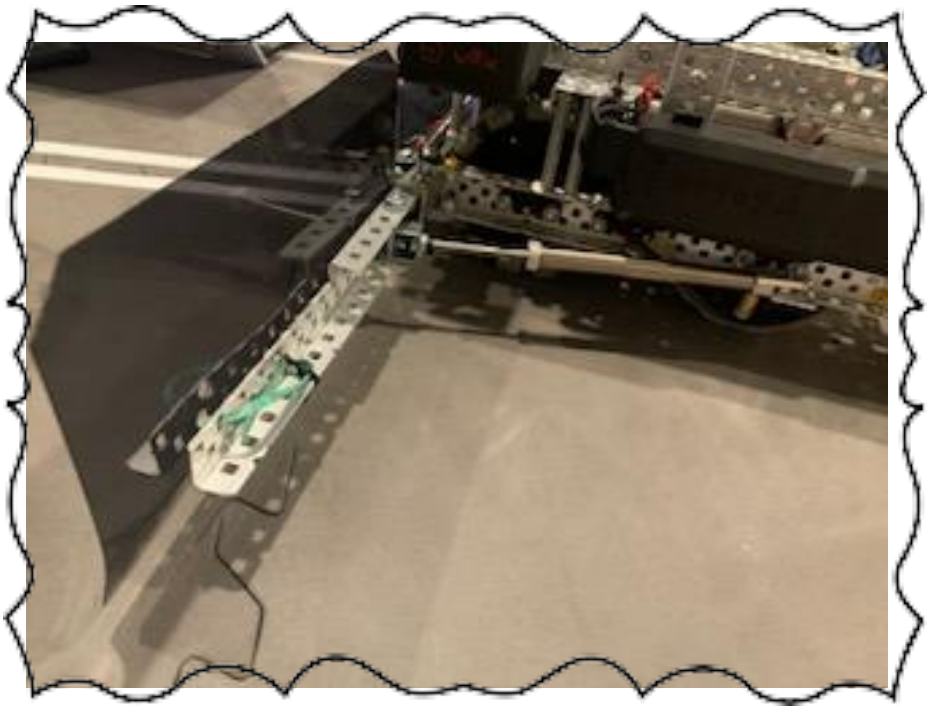
- Have the pistons tank in the inside of the drivetrain allowing it to be in a “hidden” space
- Have a reminder to constantly have our air pressure tank filled to 100.0 for the pistons to lock in place

Name: Zoe Pak

How Do Pistons Work?

- The way pistons function involves sending the force output of expanding gas in the cylinder to a crankshaft, which in turn gives the flywheel rotational momentum.





- A piston can only consistently transform heat energy into work by going through a cyclical process.

Name: Vaishnavi Alapati

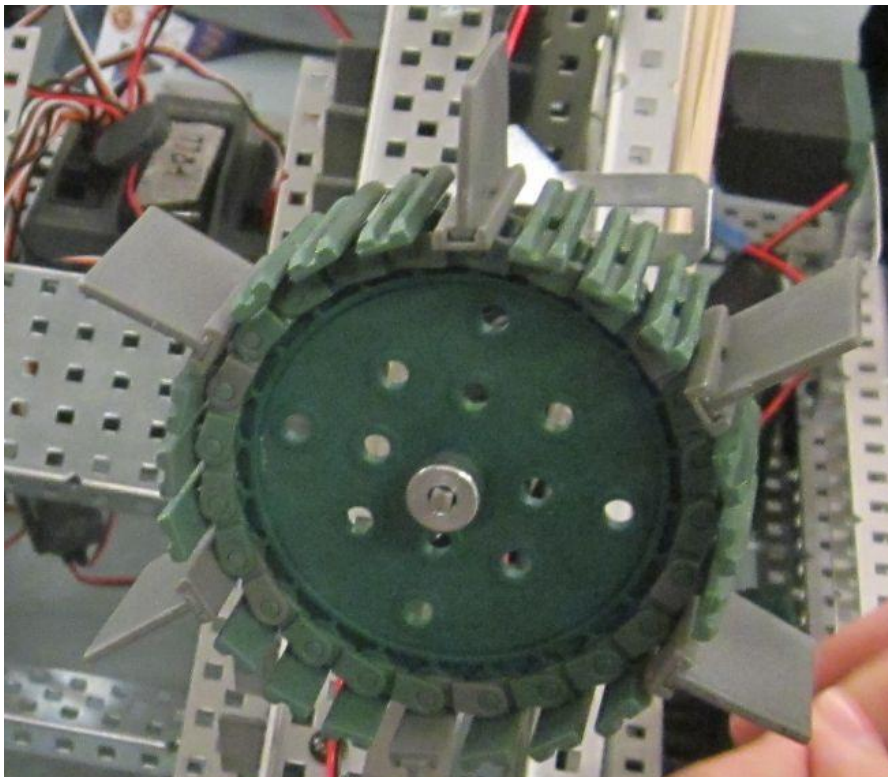
Flipper collectors

PROS:

- Can be a fast collector
- Stable
- Allows a nice base and reliability for the triballs for the robot

CONS:

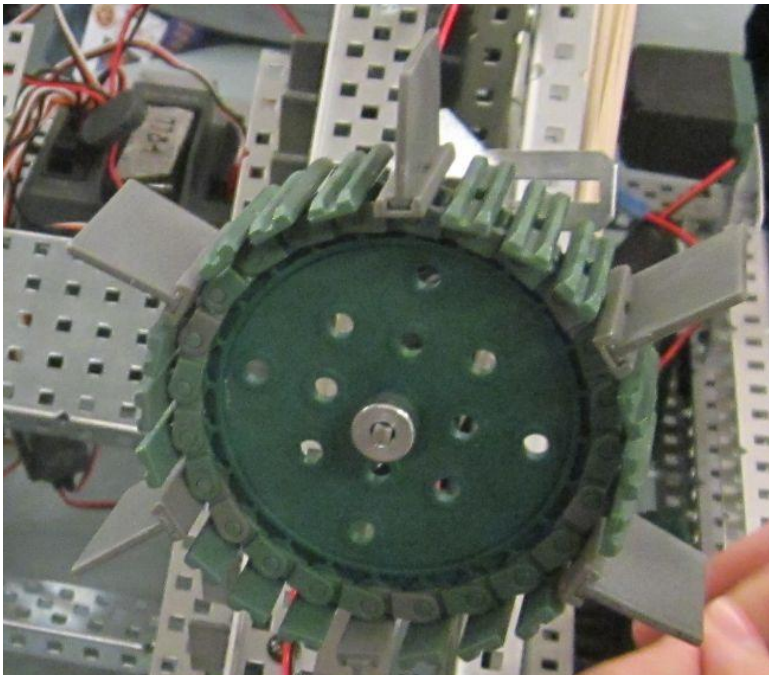
- Why do we need to be fast if we can only obtain 1 triball at a time?
- Can be a nice base, but also includes one wheel, causing it to be very heavy



Name: Zoe Pak

Flipper Collector Pt. 2

This design is an effective way to pick up triballs. It takes up less space because it both picks up and dispenses triballs. It makes the robot more compact as there are less components but also places concentrated weight on one area.



Name: Vaishnavi Alapati

Intake Mechanism Pt. 1

First Try:

Tried using double fly-wheels to roll triballs in

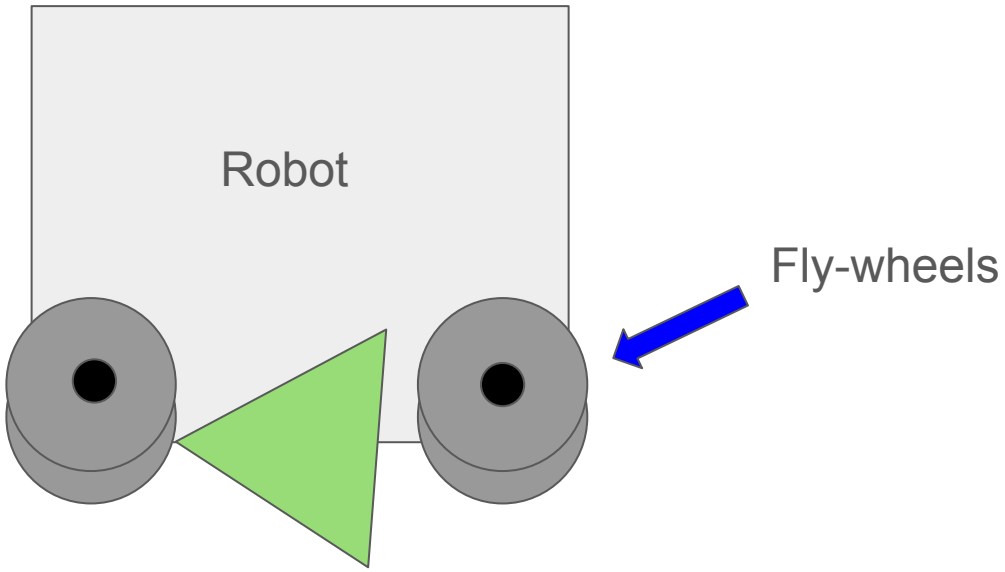
Did not work because:

- Too heavy
- Weight = more energy needed to spin
- Large sizing
- Tricky gear arrangement = difficulty modifying

Biggest problem was:

- Hard to make adjustable

To allow triballs in, entrance had to be flexible and adjustable to mold to contours of triball. Making a mechanism to make solid, heavy fly-wheels adjustable was a big challenge that suggested an easier solution lay somewhere else.



Intake Mechanism Pt. 2

Second Try:

Used rubber band roller to roll triballs in

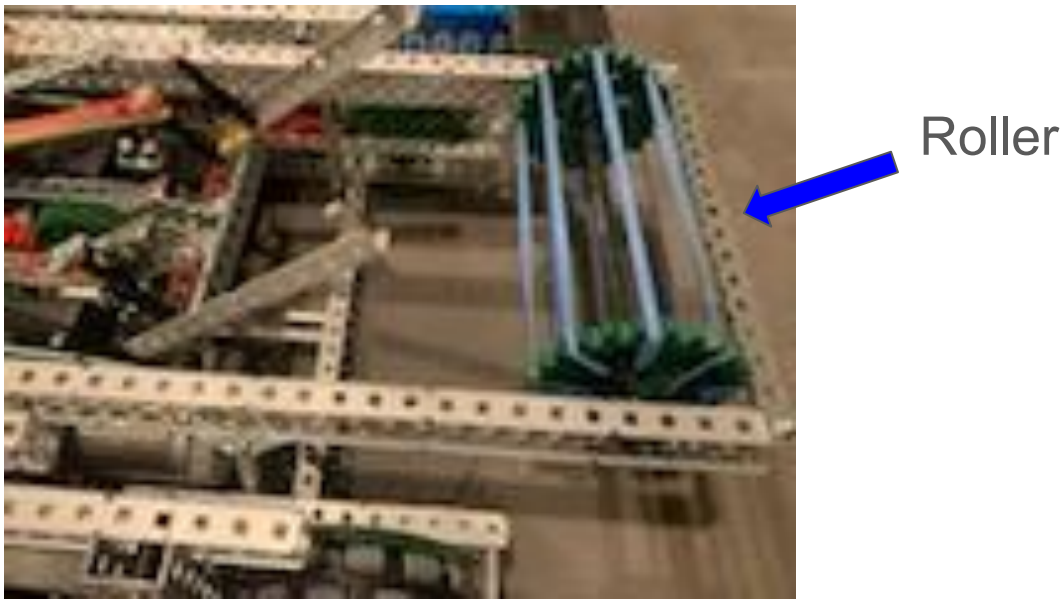
Worked because:

- Lighter
- Bands = flexible
- Compact
- Easily replacable/fixable

Stayed with this design because:

- Fast, light, easy to construct/deconstruct

The rubber bands acted as naturally-adjusting propellors to roll the triball into the catapult. It was a much lighter design that only required a frame and materials that could easily be replaced (should breakage happen).



Driving Strategy

Importance of Driving Strategy

Driving strategy plays a larger role in this year's game because there are many rules that can disqualify teams. Top 3 things to remember:

1) **Double-Zone** – An *Alliance* status. An *Alliance* meets the definition of being "*Double-Zoned*" if both *Robots* from the *Alliance* are in the same *Offensive Zone*. To be considered "in the Zone" for the purposes of this definition, *Robots* must meet the following criteria:

1. Contacting the gray tiles within the Zone
2. Not contacting the Long *Barrier*
3. Not contacting any *Elevation Bars*

2) **<SG8>** **Stay out of your opponent's Goal unless they are Double-Zoned.** During the time when an *Alliance* meets the definition of *Double-Zoning* , opposing *Robots* are permitted to "break the plane" of the *Double-Zoning Alliance's Goal*, such as to remove *Triballs*.

a. This allowance ends once the *Alliance* is no longer *Double-Zoning* (i.e., when one or both of the *Robots* has returned to the other side of the field or contacted the Long *Barrier*).
b. Entering an opponent's *Goal* at any other time is prohibited. This includes staying inside of an opponent's *Goal* after they end their *Double-Zone* status.
c. This rule applies to both intentional and unintentional interactions. *Teams* are responsible for the actions of their own *Robots*.
d. This rule only applies during the *Driver Controlled Period*. Entering an opponent's *Goal* is not permitted at any time during the *Autonomous Period*.
e. If an *Alliance* has only one *Robot* present, then that *Alliance* can never meet the definition of *Double-Zoning* , and therefore its *Goal* is never open for opponent interactions.

3)

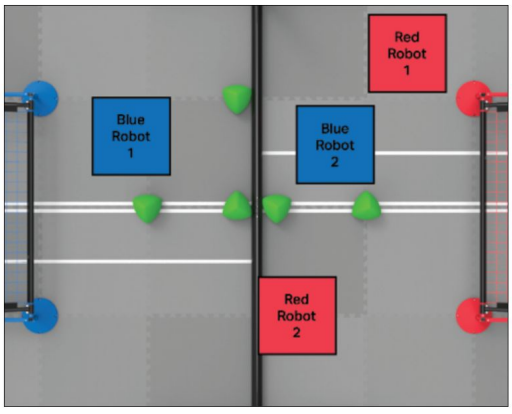


Figure 32: A Red Robot is contacting the Long Barrier; the Red Alliance is NOT Double-Zoning, therefore Triballs in Goals are safe.

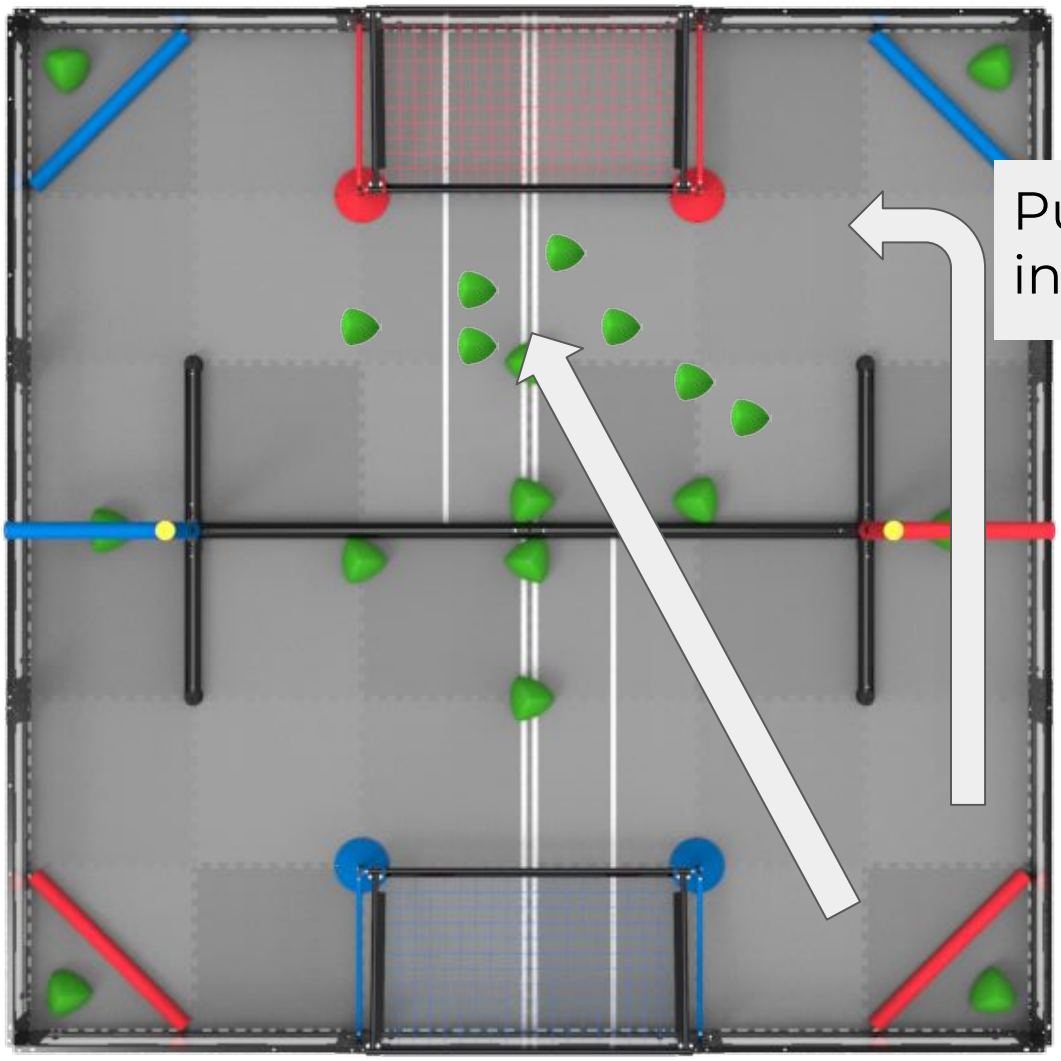
2 Strategy Choices:

- There are 2 main strategy choices to make during matches and skills
- **Option 1:** get triballs on one side of the field and go OVER the center pipe to push them in
- **Option 2:** get the triballs on one side and go AROUND the pipe–down the "alleys" to push them in
- **Option 1** usually takes more time, but could get more triballs in if they are gathered right in front of the goal (ideal for skills, where all triballs are launched at once and are undisturbed by other robots, usually resulting in an accumulation of balls at one point)
- **Option 2** could save time by avoiding the center pipe obstacle, but requires much more maneuvering on the driver's end due to tight spaces, especially with three other robots on the field

Based on the type of game (match or skills) and situation at hand, driver must make a quick decision between these two options.

Driving Strategy

Our general driving strategy for skills is to first launch of the balls to the other side of the field, and then push as many balls into the goal as we can. For team matches, we typically play the role of shooting the balls to the other side but occasionally we push the balls in the goal



Name: Daniel Wu

Programming

Code Quality Choices

No global mutable states (i.e. externs)

Task for each component of robot

Components work both with driver control and being called by other programs (i.e. autonomous)

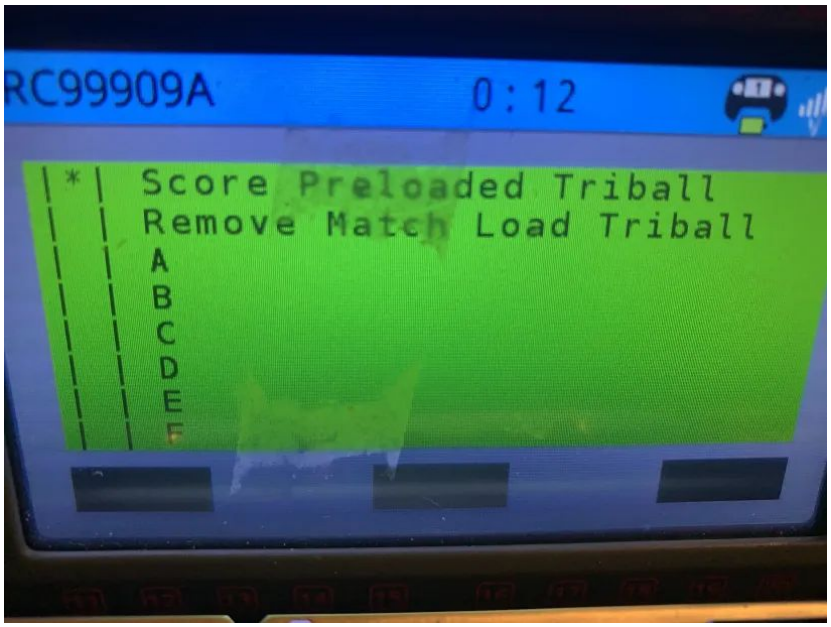
Object Oriented Programming

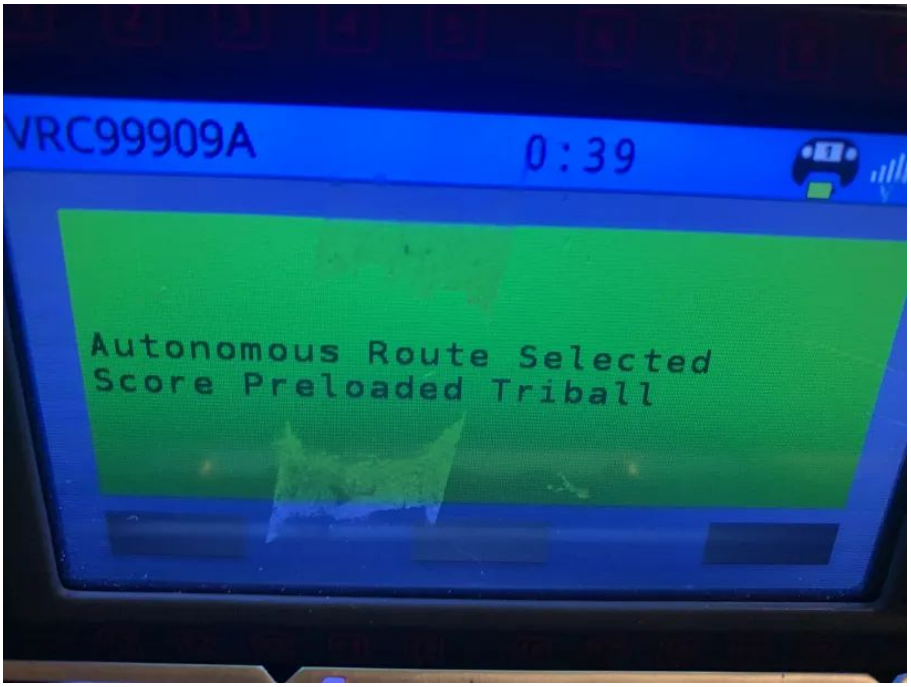
Autonomous Routes

- Grab match load triball, remove from goal, touch elevation bar
- Score preloaded ball
- Do both

Autonomous Route Selector

- Left Button moves cursor up
- Middle button moves cursor down
- Right button selects route





Code for Driver Control

```
void run() {
    pros::lcd::initialize();

    pros::Task drive_train_task([&]() { _drive_train->run(); });
    pros::Task launcher_task([&]() { _launcher->run(); });
    pros::Task feeder_task([&]() { _feeder->run(); });
    pros::Task wings_task([&]() { _wings->run(); });

    while (true) {
        pros::Task::delay(200);
    }
}
```

Runs a task for each component of the robot, i.e. the driver train, launcher, feeder, wings, etc

Wings Controller

```cpp
class Wings {
private:
    pros::Controller &_controller;
    pros::ADIDigitalOut _piston;
    bool _state;

public:
    Wings(pros::Controller &controller)
        : _controller(controller),
          _piston(WINGS_PISTON_PORT),
          _state(false) {
            _piston.set_value(_state);
    }

    ~Wings() = default;

    void run() {
        while (true) {
            bool input = _controller.get_digital_new_press(pros::E_CONTROLLER_DIGITAL_X);
            if (input) {
                _state = !_state;
                _piston.set_value(_state);
            }
            pros::Task::delay(WINGS_DELAY);
        }
    }
};
```

Opens / closes wings based on X button on controller

Launcher Controller

```
void run() {
    while (true) {
        bool incremental_movement_input = _controller.get_digital(pros::E_CONTROLLER_DIGITAL_L1);
        bool all_the_way_down_input = _controller.get_digital(pros::E_CONTROLLER_DIGITAL_L2);

        if (all_the_way_down_input) {
            _is_moving_down = true;
        }

        if (incremental_movement_input || _is_moving_down) {
            _motor.move(LAUNCHER_VOLTAGE);
            if (std::abs(_sensor.get_position() - LAUNCHER_BOTTOM_POSITION) < MOVE_ALL_THE_WAY_DOWN_EPS) {
                _is_moving_down = false;
            }
        } else {
            _motor.move(0);
        }

        pros::Task::delay(LAUNCHER_DELAY);
    }
}
```

L1 button acts as a “trigger”, giving driver full control over feeder
L2 button moves to a set position to prime the launcher for shooting

Autonomous Skills

In order to make our Autonomous Skills Route consistent, we had to do several things. First, we created a triangle of metal so that we could align the robot at a consistent angle between each run. We also made the route in a way to minimize any desprencies of going over the bar, by going over the bar, and then backing up into the bar so its aligned, and then driving straight to push all the triballs into the goal.

Competition Reflections

Justin Lee

Overall I think the competition was a success. Our team made it to the final 16 and we were able to get two autonomous win points. What I think could use improving is the rigidity of some of our plastic components, along with more robust software. I would like to desire the autonomous routes to utilize motor's encode units, so rather than moving based on time, the robots movement is more methodical.

I think another thing that we can work on is streamlining our loading, in order for our triballs to launch properly we have to orient them a specific way, and failure to do that resulted in the triballs either shooting out of bound or falling on our own side and affecting our score negatively.

Daniel Wu

I think the competition was a pretty good first competition overall. We were able to make it into the elimination rounds and performed relatively well in skills. We were able to achieve the autonomous win points for more than half of the matches, which is an improvement from last year when we almost never got autonomous win points.

The competition was a good learning experience because we got to see what other teams' strategies were. Strategies including bowling were new to us. We also realized that our robot did not need to fit under the net because there were rarely situations where we could go under the net. Overall, the competition gave us insight into many things we did not know before and allowed us to find potential improvement for our robot.

Cristina Pak

I am happy with our performance for our first competition, having made it to the final 16 with our first robot. After doing VEX for a few years now, I always expect to make big changes and adjustments after the first competition, learning from others and our mistakes. But this time, it seemed that we made proactive choices throughout the building process that allowed for an easily modifiable, flexible robot. Now, I think our objective is to see what else we can add to improve rather than discern what we need to take down.

I think one of our biggest goals should be to improve the speed of our catapult, whether that be through a whole new function (such as a platform launcher or flywheel) or by practicing our match loading skills. Another objective is to improve our autonomous skills performance, which just needs time from trial and error. Overall, I am happy with how our first competition went, and look forward to the next.

Parts List

Motors: 8 - 11W V5 smart motors
2X25 C channels - 10
2X35 C channels - 8
3X25 C channels - 4
V5 Rotation sensor: 1
V5 Pneumatics pistons: 3
4” omni-directional wheels: 4
4” traction wheels: 2
Gears - 36T high strength: 8
Gears - 36T standard: 4
Gears - 84T standard: 4
Sprockets - 30T: 1

Outreach

Library Program

For over three years, our team has been conducting monthly robotics workshops at Burke Centre Library. We consistently impart core technical and design knowledge to participants. The workshop aimed to foster a passion for science and technology by offering participants with hands-on experience in design, engineering, and STEM subjects. To further enhance STEM education in our communities, we hope to move our program to a new library this year. Ultimately, we still want to equip the next generation of scientists, engineers, and innovators with the information, abilities, and tools necessary to thrive in the rapidly changing fields of robotics and STEM.

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