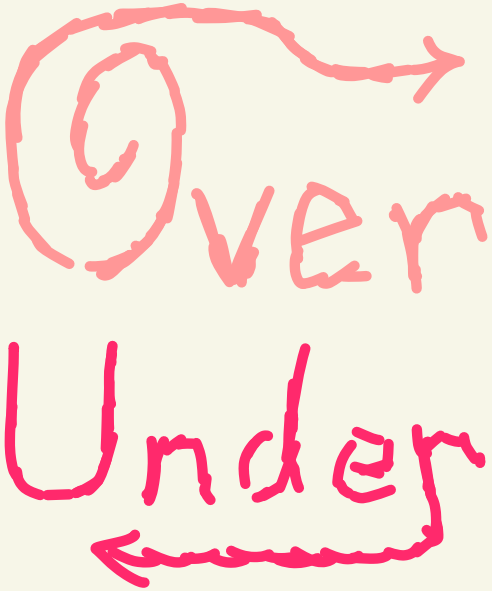
HGHS
Team 8336A



VEX V5

2023-2024

Notebook

Title (Example Page)

Subheading

- Information related to tasks we did throughout the day
  *Any further information related to the previous point
- Anything in blue is important cohesive info
- Anything in pink will serve as an exaggeration

Testing Subheading

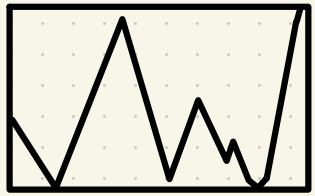
- Anything we do after a test of a certain thing of our robot, we will write it in this shade of blue under the subheading
- Names that will be listed are done with
  *These
  *Three
  *Shades

Continuous Info

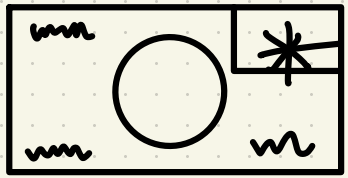
*Signature of the member who wrote the entry

Date

This side is for sketches, graphs, and pictures



- Additional graph info



- Additional picture info

- Additional sketch info

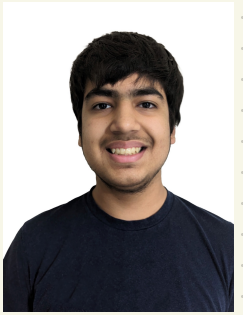
Sketch will be robotics related, this is just an example ^^

Meet the Members

4/28

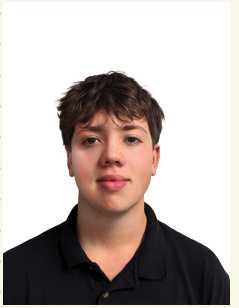
Get to Know Us

- The mastermind behind so many of our ideas, as well as our lead Builder; Alexander Blanco
- A do it all thinker that is never afraid to keep our team in check; Dylan Lachiondo
- A wizard at all things coding and someone who keeps us working at great pace; Ammar Hussain
- Another programming wizard who has a knack for tech; Jonathan Martinez
- A creative thinker with a passion for designing; Magdiel Vergel



Ammar

Jonathan



Dylan

Alexander

Magdiel

PHASE 1

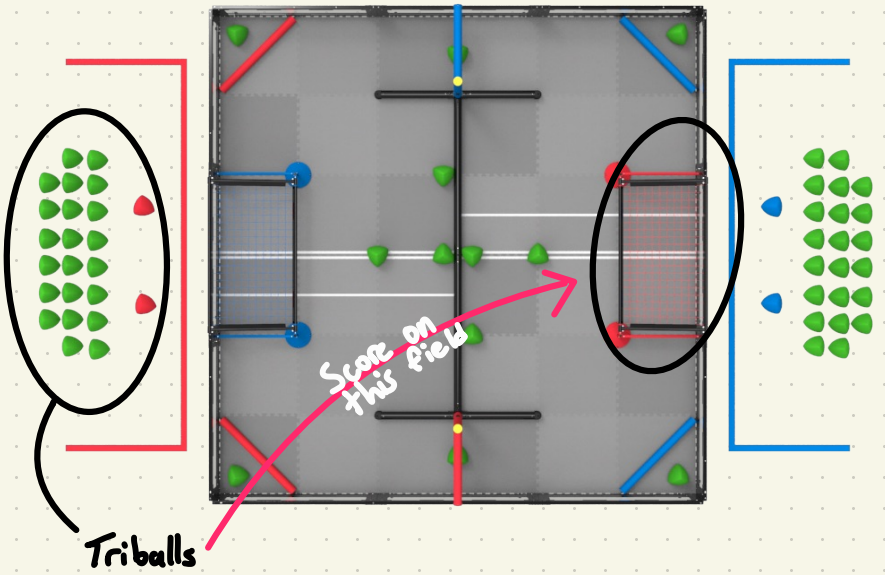
Pre-Season

Field Analysis: Day 1

4/29

The Board is In

- Our season starts with the field, as today, this year's field came out. We're going to take a couple days to analyze the board and come up with strategies
- Today, we're going to watch the field video multiple times while also going over the rule book to see what we are allowed to do
- The goal of this year's challenge is to get the triballs (the green acorns) into your colored field
- Another crucial aspect is the end game elevation, where our robot must grab onto the poll and lift itself off the ground. This looks to be a pretty daunting task, but it's a challenge we're up for
- We're looking forward to what this year's field has in store for us. There's a lot of strategic elements to it, and lots of planning that is required

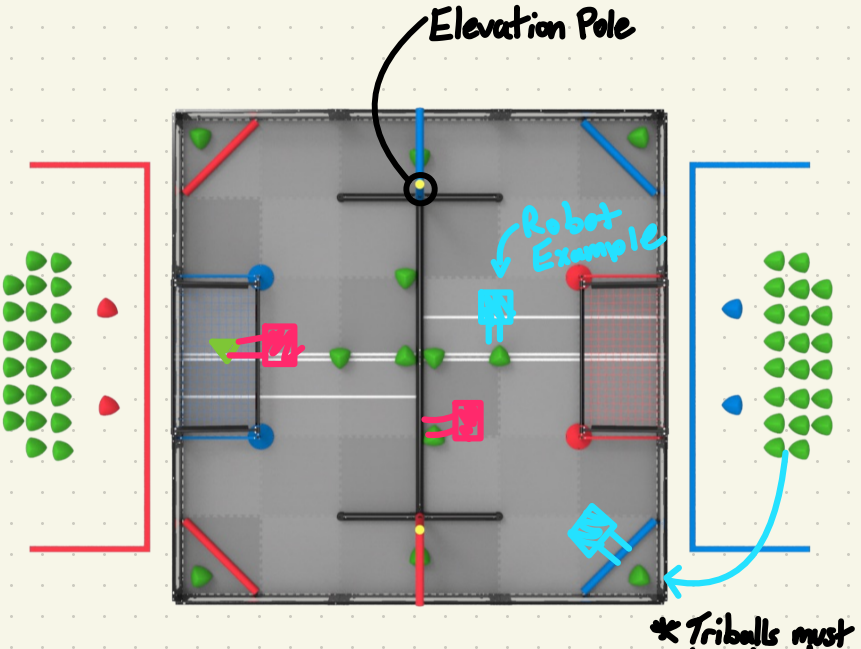


Field Analysis: Day 2

5/1

Strategize & Masterize

- Another day of dissecting the board and planning out routes and strategies. We came across a couple rules that we thought were important to build around
  - *If both robots of one team are on one half of the board, we have the ability to remove triballs from their own goal. This is called "double zoning"
  - *End game elevation protects you from double-zoning
  - *Triballs must be collected from the corner
- We want to use double zoning to our advantage and work in a way that gives us opportunities to score with it in mind
- The idea of shooting triballs to the other side to efficiently score was also brought up. Safe to say, we're all commited to contributing thoughts and ideas



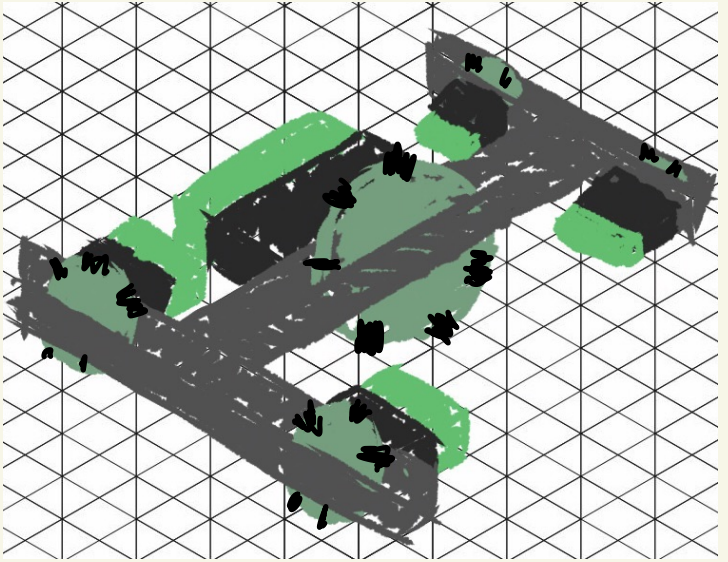
- Here's an example of double zoning. As you can see, both blue robots are on one half of the field, giving red the ability to take from blues goal

Sketching & Brainstorming: Day 1

5/2

The Start of Something Big

- After spending a couple days breaking down this year's field, we've brainstormed a couple different ideas for our robot
- We started off with ideas for our base, which has a couple of ways we can approach it
- Our ideas consisted of:
  - *An H-Drive
  - *A Square-Drive
  - *A Standard-Drive
- We're going to sketch all of our different designs to see what works and what doesn't, with today being our H-Drive



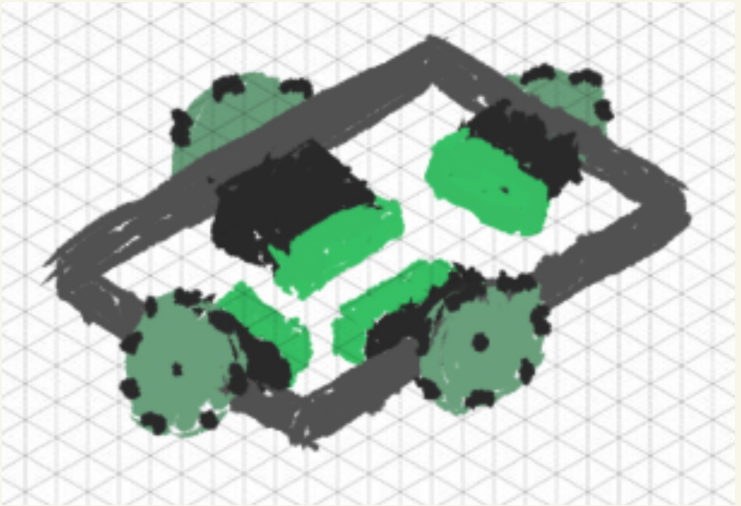
- This is a sketch of our initial idea for our base
- We finished the day realizing that H-Drive was not as easy to work with since attatching the extra part to the base wouldn't be ideal

Sketching & Brainstorming: Day 2

5/3

Sketching: Take Two

- Today, we sketched out a possible **Square-Drive** for our robot.
- Our thought process behind it was **mobility**, in which we felt that given the **four-way movement**, we'd be able to traverse while grabbing the tri-balls with ease



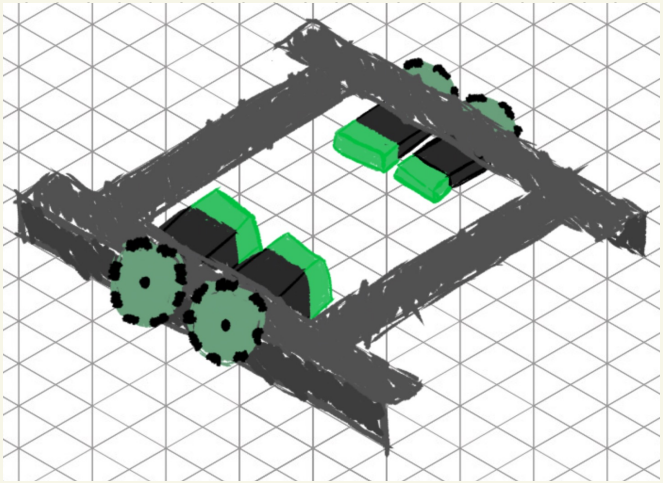
- The wheels we used were **Omni-Wheels**, which gives our robot the ability to move smoothly
- A **Square-Drive** is definitely an interesting option to our base, we'll have to see our other options and weigh in each one

Sketching & Brainstorming: Day 3

5/4

Sketching: Round Three

- Our last day of sketching had us looking at the Standard-Drive
- We sketched this while making sure the design had enough room for add-ons
- Because of this, the design looks the most optimal for our base
- Tomorrow, we'll choose a base design that we see fit, and start building off of that



- The Standard-Drive gives us a lot of advantages that the other base designs don't, which is why we are heavily considering using this base

Sketching & Brainstorming: Day 4

5/5

The Decision

- After careful consideration and a lot of back and forth, we decided that the Standard-Drive was our best option
- We considered many different factors and came to the conclusion that the Standard-Drive gave us much more room to work with, and ultimately gives us what the other buses couldn't
- Next week, we start moving towards building our first iteration of our base

Grading Criteria	Scale	H-Drive	Square-Drive	Standard-Drive
Ease of Building	1-3(Higher = Easier Build)	2	2	3
Driving and Mobility	1-5	3	2	4
Twisting and Turning	1-3	2	5	3
Power Usage	1-3(Higher = More Efficient)	2	3	2
Average Speed	1-5	4	3	5
Resistance to Shoving	1-3	1	1	2
Ability to Strafe	0-5	5	5	5
Add-On Compatibility	0-5	2	3	4
TOTALS	----------	21	24	28

- This is the decision matrix we used to decide our final base
- The Standard-Drive had a little bit of everything as well as being a design we are a familiar with

Weekly Recap #1

- At the end of every week, we're going to recap our weeks progress to make it easier to reread
- As for this week, we succesfully sketched and decided on a design for our base
- We're looking forward to start the building process next week, starting with the wheels

Gear Ratios: Omni-Wheels

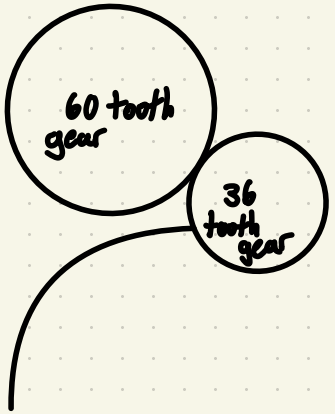
5/8

Mathmaticians at Work

- Today was a day spent entirely on gear ratios
- There was a lot of back and forth when it came to picking the best one, but we ultimately decided on the one shown below

60 teeth gear
÷36 teeth gear

- Final gear ratio = 1.67



- This is the gear that is connected to the axle

Base Building: Day 1

5/9

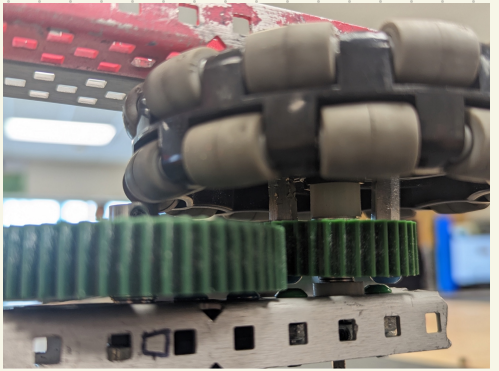
Locked In

- Our first day on building pace was pretty productive
- We started our building journey with our wheels, in which we're using omni-wheels to provide more mobility
- We're prioritizing the use of steel to make our robot lighter and, in turn, faster and more mobile

Some Coding Too

- Weive also got to work on a bit of our code, more specifically our P.I.D. loop
- For those unaware, the point of a P.I.D. is to make motors start and run smoother, while also giving more accurate measurements within the autonomous program
- Still very rough, however it's progress. We'll build on what we have with time
- As for now, we have a good controller settings for once we finish our base

1



- We are currently focussing on the gear ratios in order to see what works best for the robot
- We're trying to get the absolute most out of ur wheels, so we might spend another day focusing on just the Math of it

2

```
// VEXcode device constructors
controller Controller1 = controller(primary);
motor leftBackMotor = motor(PORT12, ratio18_1, true); // rear left motor
motor leftFrontMotor = motor(PORT5, ratio18_1, true); // front left motor
motor rightBackMotor = motor(PORT17, ratio18_1, false); // rear right motor
motor rightFrontMotor = motor(PORT16, ratio18_1, false); // front right motor
motor flexWheel = motor(PORT4, ratio18_1, false); // flex wheel
motor secondFlexWheel = motor(PORT11, ratio18_1, true); // secondary flex wheel
motor_group LeftDriveSmart = motor_group(leftBackMotor,leftFrontMotor);
motor_group RightDriveSmart = motor_group(rightBackMotor, rightFrontMotor);
drivetrain Drivetrain = drivetrain(LeftDriveSmart, RightDriveSmart, 320, 279.4, 279.4
```

Base Building: Day 2

Wheels on Deck

- Our second day of building had us making the main base where the wheels would be connected
- We prioritized a **two gear set up**, which prevents the motors from **overclocking**
- **Dual motors** was also a focus, as it gives us more **efficiency** on the drivers end.
- **Standoffs** and **washers** were used to make sure that the wheels have **zero interferance** with the wheels

- **Side profile** of the wheels' base

Base Building: Day 3

5/11

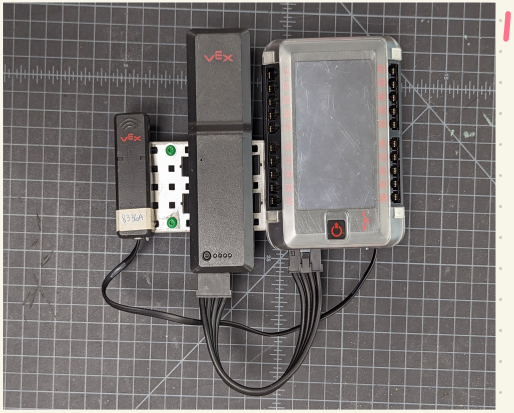
Power Installation

- We're going to take a short break from the wheels and move onto setting up the aspect of our base that holds the brain
- For a little bit of context, the devices are as follows
  - *To the left is our vexnet, which makes the brain bluetooth compatible
  - *The middle is the battery, which powers the brain. Pretty self explanatory
  - *The right is the brain, which stores our programs!
- We put it all in a flat steel plate in order for it to be easily attachable to any future base we make
- The brain was also configured properly to run future programs

P.I.D. Advancements

- Moving forward with our P.I.D., we got some tuning done with the joystick in terms of the velocity info gathering, as well as it's RPM management

1



- Birds eye view of our brain base

2

```
int printRpmThreadCallback () {
  // Gets the RPM of the left rear motor and stores it in a variable.
  int leftBVelocity = leftBackMotor.velocity(rpm);
  // Prints the velocity using the variable to the terminal.
  std::cout << leftBVelocity << std::endl;
  wait(1000, msec);
  this_thread::sleep_for(10);
  return 0;
}

int joystickThreadCallback() {
  // Performs a callback to the curveJoystick function, taking Axis 1 and Axis 3 of the controll
  double turnVal = curveJoystick(turningRed, Controller1.Axis1.position(percent), turningCurve);
  double forwardVal = curveJoystick(forwardRed, Controller1.Axis3.position(percent), forwardCurv

  // Converts the values obtained from the above callbacks to voltages by multiplying by 0.12. (
  double turnVolts = turnVal * 0.12;
  double forwardVolts = forwardVal * 0.12;

  // Applies the voltages to the motors.
  LeftDriveSmart.spin(forward, forwardVolts + turnVolts, voltageUnits::volt);
  RightDriveSmart.spin(forward, forwardVolts - turnVolts, voltageUnits::volt);

  thread printMotorRPM = thread(printRpmThreadCallback);

  // Forces the thread for 10 milliseconds to sleep to prevent it from using all of the CPU's re
  this_thread::sleep_for(10);

  // A threads's callback must return an int, even though the code will never
  // get here. You must return an int here. Threads can exit, but this one does not.
  return 0;
}
```

5/12

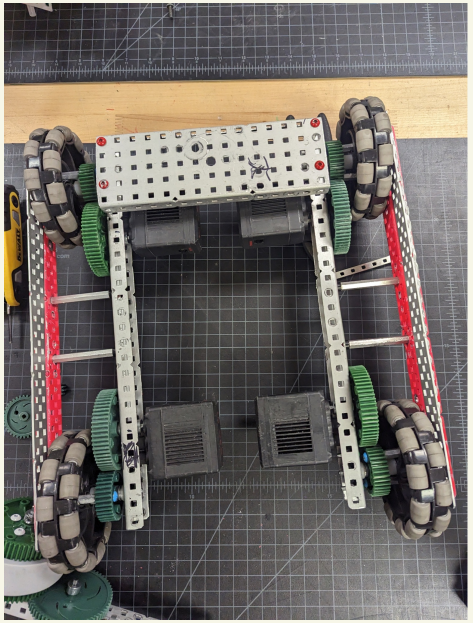
Base Building: Day 4

Wheel on Wheel

- Last day of the week so we wanted to wrap up with the wheels
- We connected the wheels with a base steel plate in a way that makes it so that the wheels aren't congested on the sides
- This is all still a work in progress though, and the overall design might change. Nonetheless, we're happy with what we have now

Weekly Recap #2

- This was a really productive week for us, as we were able to work at a steady pace
- Next week, we plan on adding the brain to the base, and then take it from there

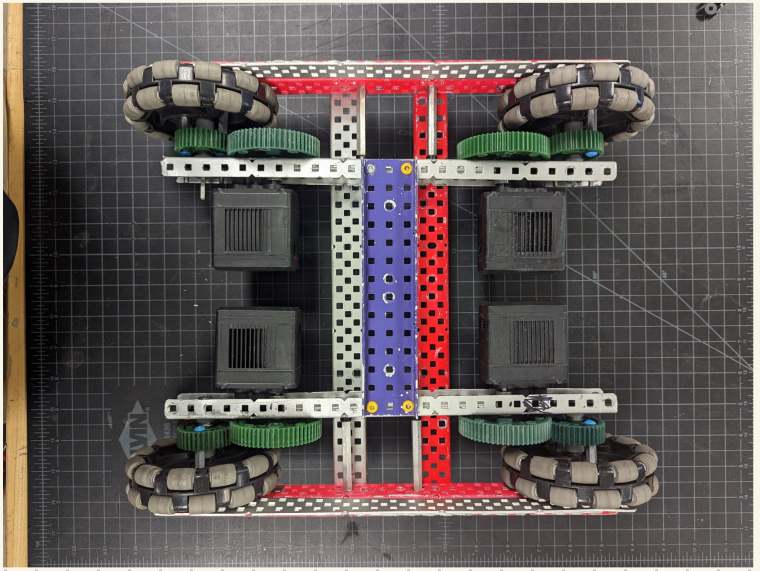


- As you can see, still very much a work in progress

Base Building: Day 5

Retool and Revamp

- Over the weekend, we did some thinking and redid a bit of the base
- We focussed more on having a more balanced center that gives the robot more stability on all sides
- Not only did it pass the eye test, but it was also more sturdy simply holding it. It doesn't move around as loosely anymore and it's much harder to twist and bend
- The wheels were also less loose with this change, which is just the cherry on top for this design
- Once we finish with the brain compatability, we'll attach it and take it from there



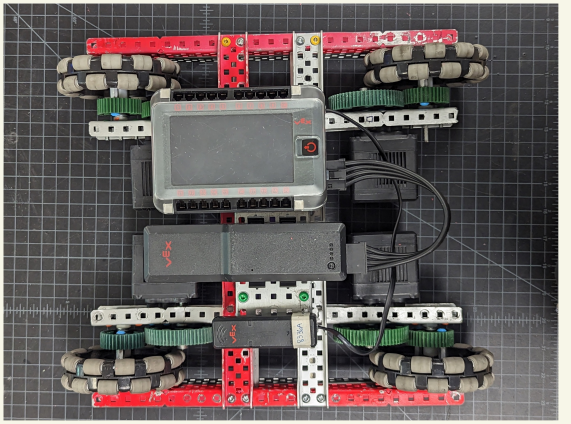
- The use of flat plates on the side as well as standoffs gave us the stability we needed

Base Building: Day 6

Finished Product!!

- Our base is finished... for now. Like all things are in robotics, everything is subject to change
- Nonetheless, we have something complete that will serve us for the time being, and for that we are proud of
- The brain itself was very attachable and easily accessable. It's a perfect fit that doesn't get in the way. It's really all we could ask for
- We also got some work on our P.I.D.[2], which is explained on the right
- Moving forward, we want to get some progress done on a potential claw before we move into other projects and eventually summer break

1



- It's functional, it's stable, and most importantly, it works

2

```
// Constants for the PID controller
const double kP = 0.4;  // Proportional gain
// const double kI = 0.0;  // Integral gain - Not recommended for drivetrain, so it is left
const double kD = 0.90;  // Derivative gain

const double turnkP = 0.0;
const double turnkD = 0.0;

int targetDistance;  // Desired distance to travel
int targetTurnValue = 0;

// Variables for the PID controller
double error, integral, derivative, lastError;
double turnError, turnIntegral, turnDerivative, turnLastError;

// Controlling PID Function
bool resetMotorValues = false;
bool enablePIDFunction = true;


// Function to calculate the PID output.
int calculatePIDOutput() {

  // Reset motor values to 0 once program is initialized and PID loop is enabled.
  while(enablePIDFunction) {
    if (resetMotorValues) {
      resetMotorValues = false;

        leftBackMotor.setPosition(0, degrees);
        leftFrontMotor.setPosition(0, degrees);
        rightBackMotor.setPosition(0, degrees);
        rightFrontMotor.setPosition(0, degrees);
```

Claw Prototyping and the End of Phase 1

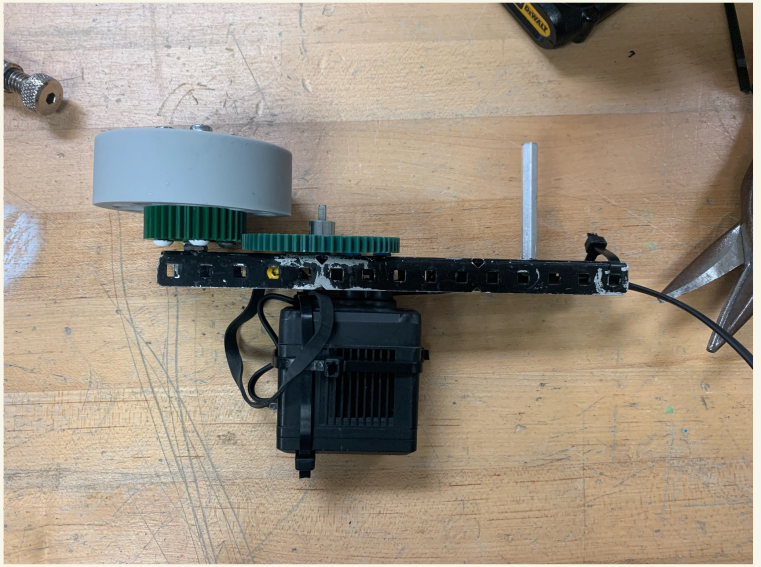
Last Minute Prototyping

- For now, we're going to pause with our robot as we have other preparations we have to get to, as well as our summer internship. Realistically speaking, we won't have time to get back to this until school starts again
- Despite that, we still prototyped a potential claw design to at least leave with something
- The idea is to have one on each side so it can intake the tri-balls efficiently and spit them out easily. We'll build upon this design in the future

Phase 1 Recap

- We could not be any happier with the progress we made
- To already have
  - *A base
  - *A strategy
  - *An intake prototype

  all before the season officially starts is exactly where we wanted to be, and we're proud of all our progress
- We'll return in a couple months eager to continue!



- The potential design for our intake

PHASE 2

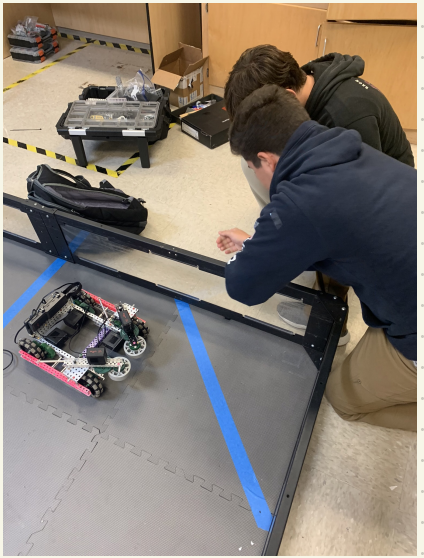
2023-2024 Season

Phase 2: New Beginnings

8/22

Bigger Ambitions

- And we're back! A new school year has reached upon us and with it comes a new Vex Season
- With school back in business, we now have loads of time to work together as a team and continue from where we left off
- As for today, we spent the day entirely on fixing up the room we'll be working in this year. Lots of cleaning, moving, organizing
- What's good about this room is that it gives us easy access to test anything, as we have the field is accessible right next to us. It's also giving us a spacious room to work with
- We're excited to see where this year takes us, and we're even more excited to start working



- Strategic thinkers at work

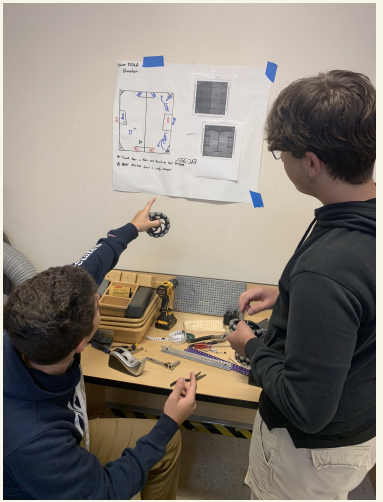
8/24

Sketching, Planning, and a bit of Strategic Thinking

Plotting for More

- Now that our room is all nice and tidy, we can start getting to work early. Some might think it's too early in the year to do so, but our motivation says otherwise
- To serve as a little refresher, we spent our time today planning an outline for our year, as well seeing where we take it from here[1]
- Our biggest takeaway from all this is our decision on making a new base... kind of
- While our already built base works wonders, it does have a couple minor inconsistencies, specifically with the movement and autonomous programming[2]
- We also discussed an addition of a shooter to our final design, in which we shoot triballs to our scoring side. All of this can be explained when we get into it though, as our focus now is on a bettter base

1



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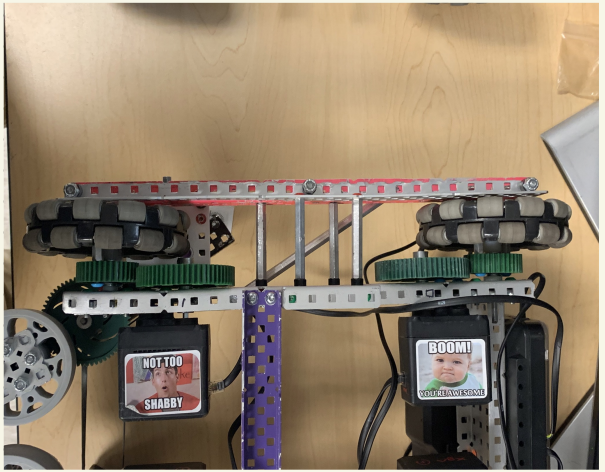


8/25

Wheel Prototyping

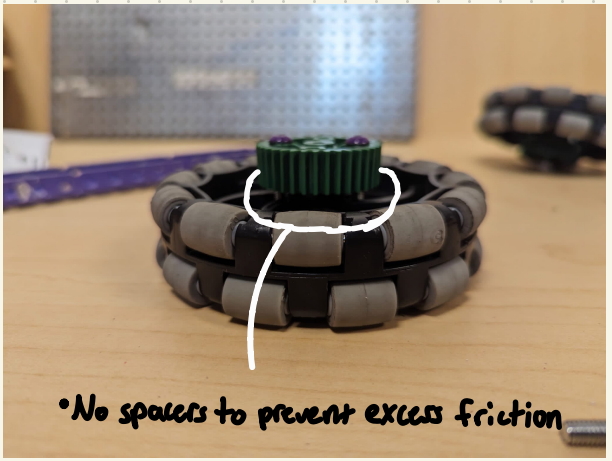
Ideas All Around

- Moving forward with our design of a new base, we're going to start on potential wheel designs
- We're keeping our same Standard-Drive, but changing up some wheel proportions and ratios
- Our focus is on making the wheels less wobbly by attaching the proper gears to it
- We also plan on putting new standoff locations on our aluminum c-channel, which hopefully improves our stability
- With all that in mind, we still plan on keeping our overall base relatively the same, just with different wheels and openings for any add-ons we decide to put on

Weekly Recap #3

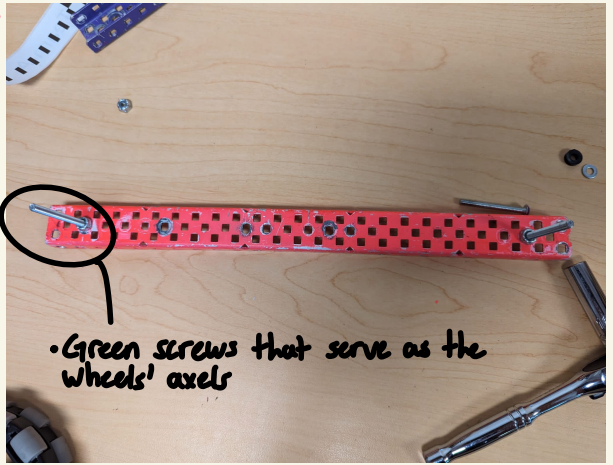
- A week of school down and we're already at a good pace
- We have a good idea for where we want to take the wheels from here, and are looking forward to what this year will bring

1



- No spacers to prevent excess friction

2



- Green screws that serve as the wheels' axels

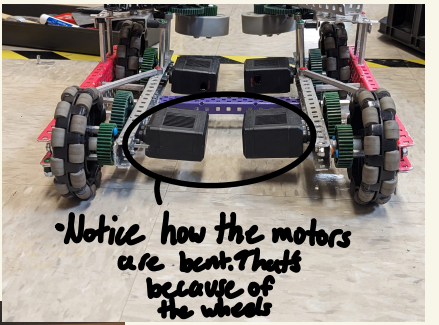
Wheel Building: Day 1

8/28

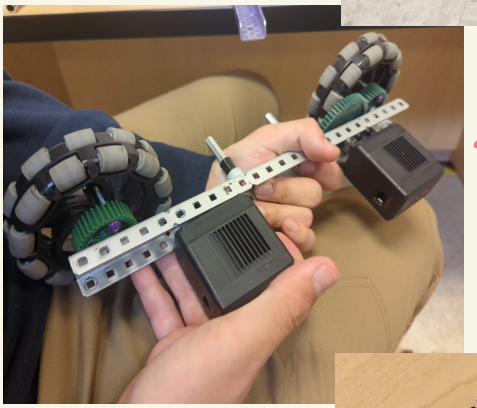
Smooth Like Butter

- Another week of building, this time with our wheels
- We've created a general design for our wheels, in which after testing them out, the design is a huge upgrade from what we had before!
- What our old base lacked was a strong and smooth driving experience, and hopefully the finished product can prove our assumption of a smoother experience
- From just spinning the wheels, we can already feel the difference in the smoothness and reaction to friction
- One thing we did keep was the same gear ratios, as our previous design

1

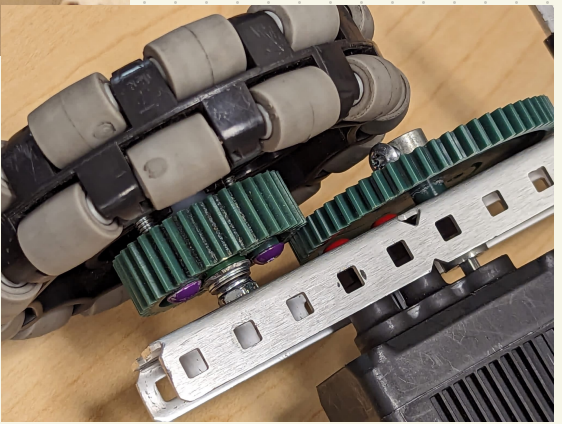


- Notice how the motors are bent. That's because of the wheels



2

3

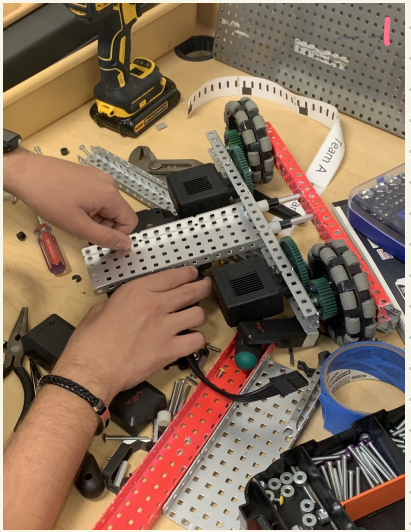


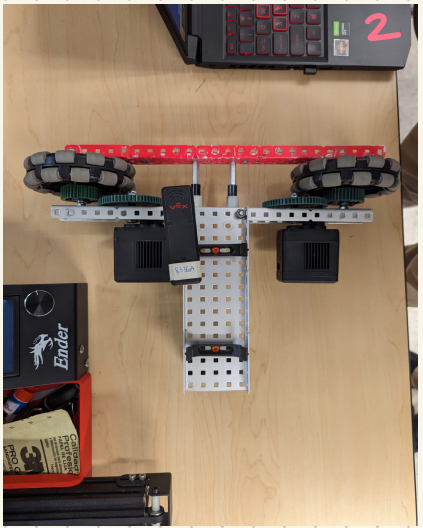
Wheel Building: Day 2

8/30

Wheels on Deck With a bit of Code

- Progress is flowing as per usual. We've gotten lots of work done on the wheels and motors!
- So far, our base and wheels are all attached smoothly and it's looking like are base is going to have a high level of control we've never felt before
- The use of standoffs[2] gives the wheels a lot of room to breath, which gives us not only more room for error, but also a less likeliness of there even being errors
- With all that is being worked on, we're also making progress on our P.I.D.[3]
- In order for our autonomous to work alongside our P.I.D., we need to have some presets in order to function
- This part of the code calculates values related to distance and RPMs





3

```
/*---------------------------------------------------------------------------*/
/*                          Pre-Autonomous Functions                         */
/*---------------------------------------------------------------------------*/

void pre_auton(void) {
  vexcodeInit();

  Drivetrain.setStopping(brake);
  LeftDriveSmart.setStopping(brake);
  RightDriveSmart.setStopping(brake);

  Brain.Screen.drawImageFromFile("smartness.png", 0, 0);



}

void autonomous(void) {
  vex::task autonomousPD (calculatePIDOutput);

  enablePIDFunction = true;
  resetMotorValues = true;

  targetDistance = distanceToTheta(18);
  waitUntil(error == 0);
  resetMotorValues = true;
  targetDistance = distanceToTheta(-18);



  vex::task::sleep(500);
```

Brain and Battery Installation

9/1

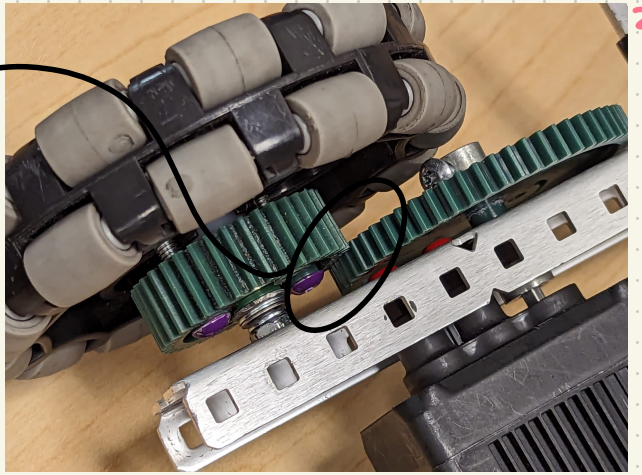
Powered and Wired

- We're nearing our end of the finished base, with just a few tweaks left
- Today, we installed our brain in a relatively unique way. The use of standoffs raises the brain to be more accessible, while keeping it easily removable in case we want to change its location
- Our cables are all connected, and our battery is all loaded. As I'm writing this, we've yet to drive our base, so below will be our reactions right after we do

1

The Aftermath

- We have a lot to unpack. The drive train is fine but we encountered a really big issue
- Something we noticed is the minimal spacing between both gears, which leads to them slipping off while driving
- This is an issue that needs fixing ASAP, as our drivetrain is pretty much useless with this issue
- We'll go back to the drawing board and see how we fix this issue

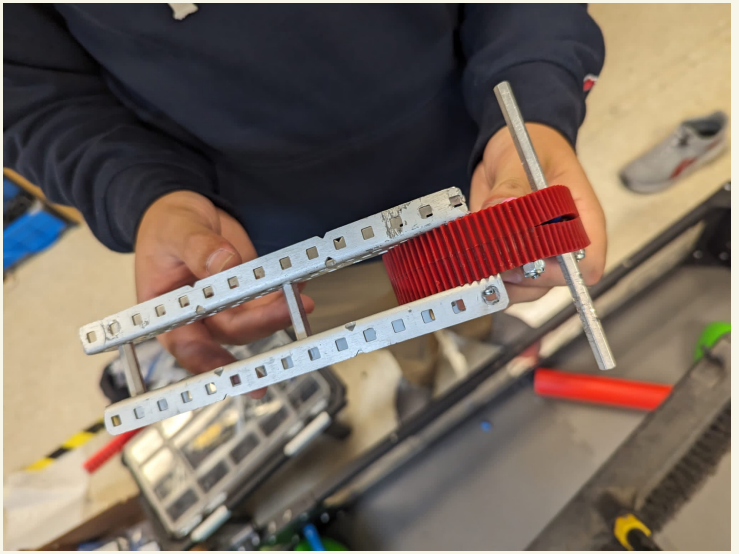

2

- Minimal space to work with

Catapulting: Day 1

The Next Big Thing

- As we continue to fix up a few things on our base, we're gonna start prototyping our catapult
- We don't have much time to waste, so we've decided split up some of the workload and work on different things at once
- We're gonna make a catapult that uses rubber bands to launch triballs to the other side in hopes that our teammates can push in the triballs
- Our idea is to use a gear with some teeth cut off in order to have the big red gear move and then snap back into position, which launches the triball
- There's still a lot of work to be done, but we have faith that we can engineer a design that gives us as many advantages as possible

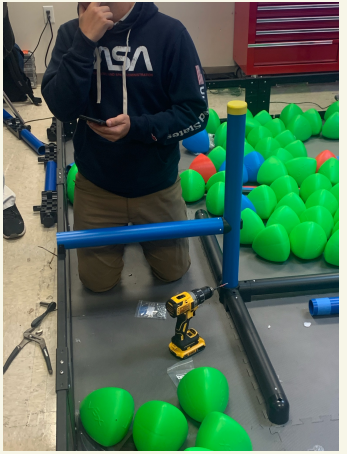


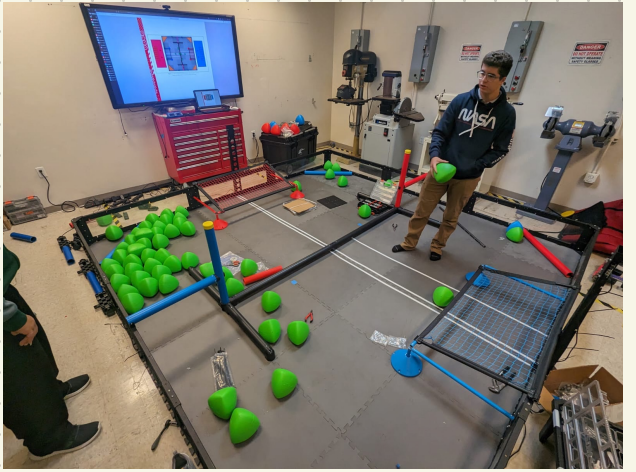
Field Building Interlude

9/8

Quick Intermission

- We have to put our work on pause for just a second, as the parts for this years game finally arrived. We're gonna build this really quickly, then get back to our regular schedule
- In light of other news we have signed up for our first competition! It's the Best of SoFlo competition in Naples on September 30th.
- We're excited to finally get the opportunity to put our skills to the test, and the added pressure will only fuel us to work even harder



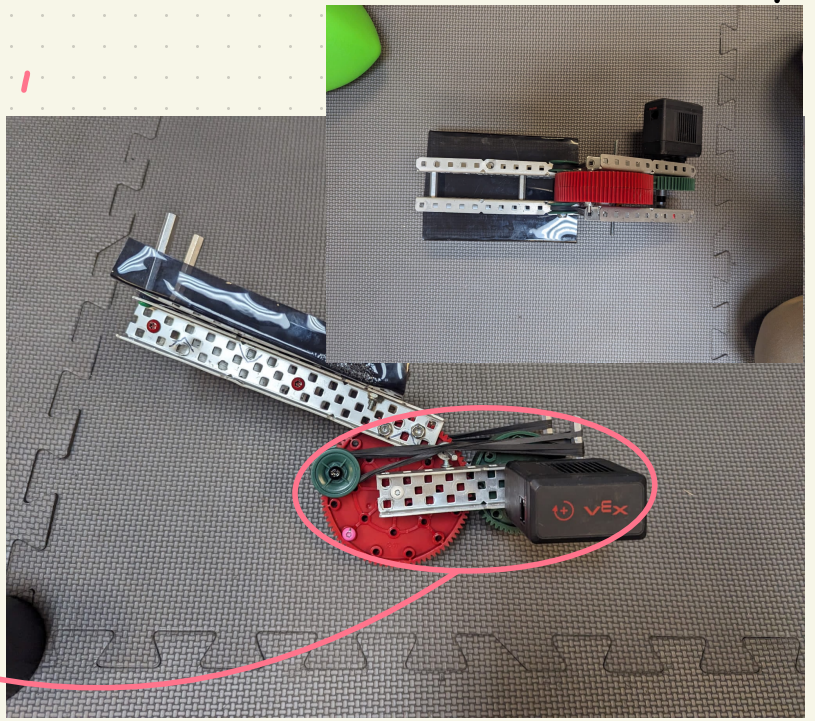


Catapulting: Day 2

Step by Step

- Day 2 of our initial catapult build has us making our main piece of the holding area of the catapult
- Our focus today was on making the platform for the triballs, while also attaching the bottom gear so it can launch!
- The gear ratio for the catapult will be:

60:84
0.7143 Ratio



After Testing

- We realized that the torque was too little, making the gears not function as intended
- The gear ratios are definitely getting changed, with the new one being a:

36:84
0.4047 Ratio

- The decreased ratio increases power, giving the gears more fluid movement
- We'll keep working on it, and hopefully the torque fixes the issue

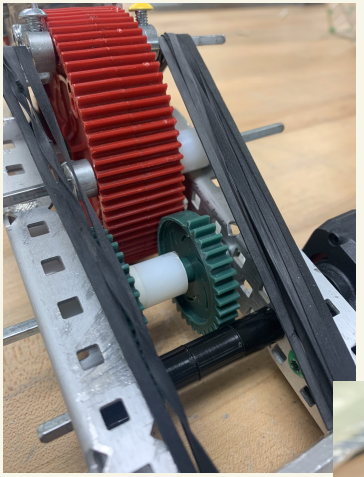
Catapulting: Day 3

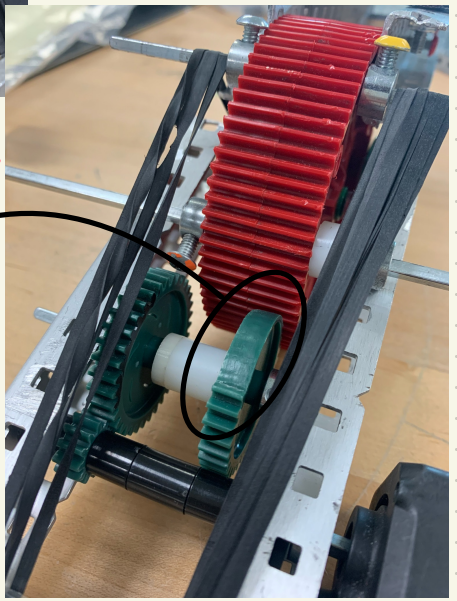
Locked and Loaded

- Our third day of working on the catapult has us finally attaching the new catapult all together
- This, of course, comes with the fact that we finally got our catapult to work
  *We got some gears changed! and moved around some parts to get it done, but we got it done and that's what matters
- The way the final product works is that the smaller gear spins on the shaved gear* to the point to when it reaches the shaved area, the rubber bands snap back, launching the resting arm forward and, in turn, the triball as well
- We did some testing and everything is running smoothly. Hopefully it's not a one hit wonder!

Weekly Recap #5

- Lots of progress was made this week, specifically with the catapult
- We got it to shoot efficiently, all that's left is to attach it to the base and keep moving forward





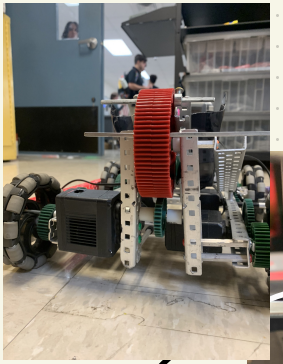
Shaved gear

Catapulting: Day 4

9/18

Catapult Connection

- A start of a new week means a new beggining for our work. As for today, we finally managed to connect our catapult to our base[1]
- The catapult was connected via screws and nuts[2], so it's nothing too crazy. It's a simple connection but it's been working so far
- We had a couple issues tuning the motor location when putting on the catapult, but all it took was some minor relocation to get it fixed
- The rest of the day was spent doing lots of testing with the launcher[3] to make sure everything is picture perfect, and so far, that's looking to be the case. The triballs are getting launched at a good rate, and outside of some rubber bands snapping, everything is staying in tact
- We'll keep testing with now, but for now, having this amount of progress done is a major accomplishment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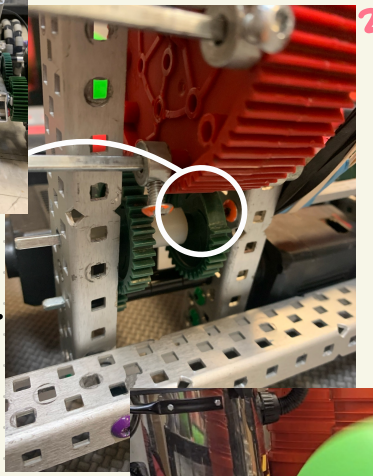
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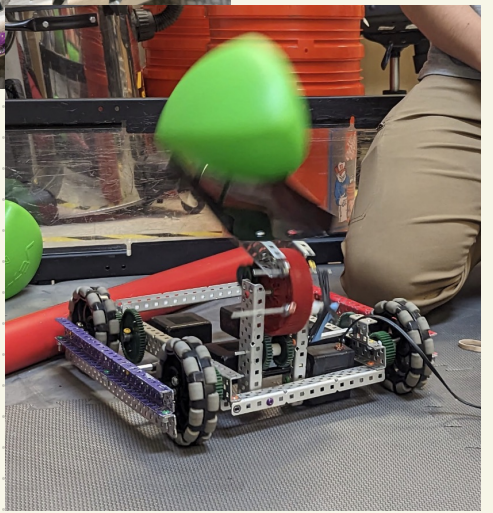
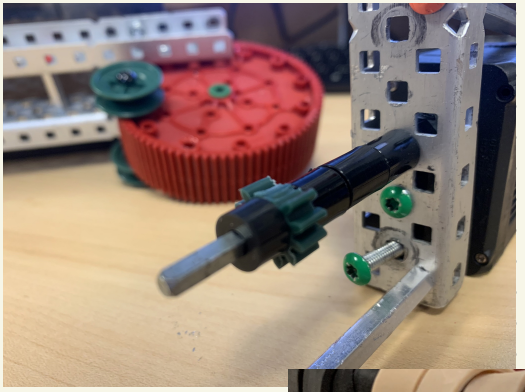
- Sheared gear that snaps the catapult back

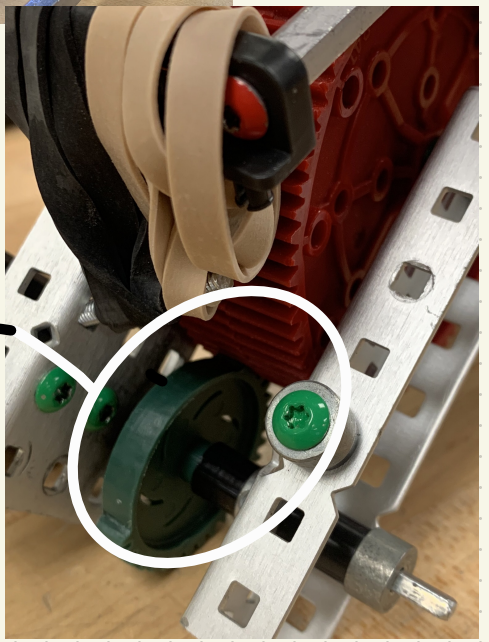

3

Catapulting: Day 5

Bouncing from Failure

- We did some further testing and... the small gear of our catapult broke!
- The gears for our robot head too much torque, meaning that it reached a point where the small gear snapped
- The rubber bands also caused too much tension, making the whole unit go on the brink of breaking every time it launched
- All this was unfortunate since we had a good work flow going. Luckily for us, we already have some solutions
- We're going to take off the tiny gear and connect the axle straight into the shaved gear and rearranging the rubber band placements to decrease the tension
- It sucks that all our momentum got killed, but so is the robotics process. We'll keep moving despite this





- Shaved teeth made for the red gear to snap back

Catapulting: Day 6

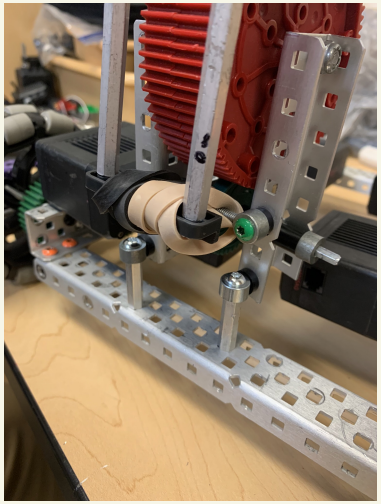
Tuning and Tweaking

- We're moving quickly on fixing our catapult from last class's blunder
- Today, we finished tweaking the gears to give it proper torque, while also giving them a proper attachment to the base!
- Standoffs were used to give the catapult the best altitude and angle when shooting
- While that keeps getting worked on, we're going to work on our "wings" mechanism
- What we mean by wings is a mechanism in which some long flaps extend on the sides of the robot, giving it more space to push the triballs[2]
- Our idea is to use 10 inch flaps to give us an easy system of going in and out, with the flaps being Aluminum plates with door hinges[3]

Weekly Recap #6

- Pretty rough week all things considered. We had to restart our catapult design but oh well, so is the beauty of the engineering process
- We have one week to get ready for Naples, so it's time we start working overtime to make everything happen

1



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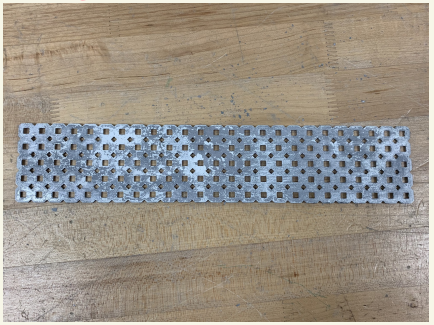

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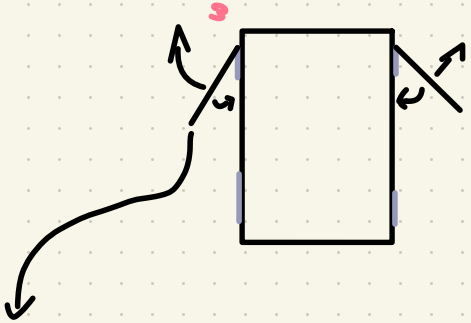

- Flaps go in and out depending on if we're using it or not