

54594B

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Pratit Wagholikar:



Advaith Rajagopalan:



Govind Krishnan:



Wednesday 5/10/23

## Over Under 2023-2024 Game First Thoughts

### Note worthy Details:

- Game objects - Acorn shaped triballs (6.19 in / 18.7 cm)
- 60 triballs - 1 preload per robot, 12 on field, 22 match loads
- Netted goals on both sides
- 5 points per ball scored in goal
- Offensive zones on both sides separated by black PVC pipe
- Triballs scored in offensive zone worth two points
- Robots can carry only one triball at a time
- 2 match load zones (for match loading triballs) per side (match load zones and goal for same alliance are on opposite sides of the field)
- Robots start with one robot per team in each offensive zone
- Robots start (can start) with one alliance colored triball
- Alliance colored triball are worth points to given alliance no matter what goal it is scored in
- Double Zoning - both robots on same alliance are in the same offensive zone - triballs in goal are not safe

### Elevation points based on other robot's elevation Thoughts and Possible Strategies

- Easier to score
- Match loads are very important
- Cascade Lift maybe?
- More defensive game

Wednesday 5/10/23

## Strategies + Design Ideas

### Design Statements

- Design, build, and compete with a robot that can efficiently score game objects in goals and offensive zones and efficiently match loads game objects

### Constraints

- Robot must fit in an 18" x 18" x 18" cube
- VEX materials only
- 8 motors only
- Robot must have autonomous to be effective

### Strategies (match set up)

- pick up one tri ball
- place or push under goal
- be able to match load tri ball fast and efficiently
- have a high bar elevation

### Robot Components

- Intake
- Outtake
- Drive
- Lift

### Offensive Strategies

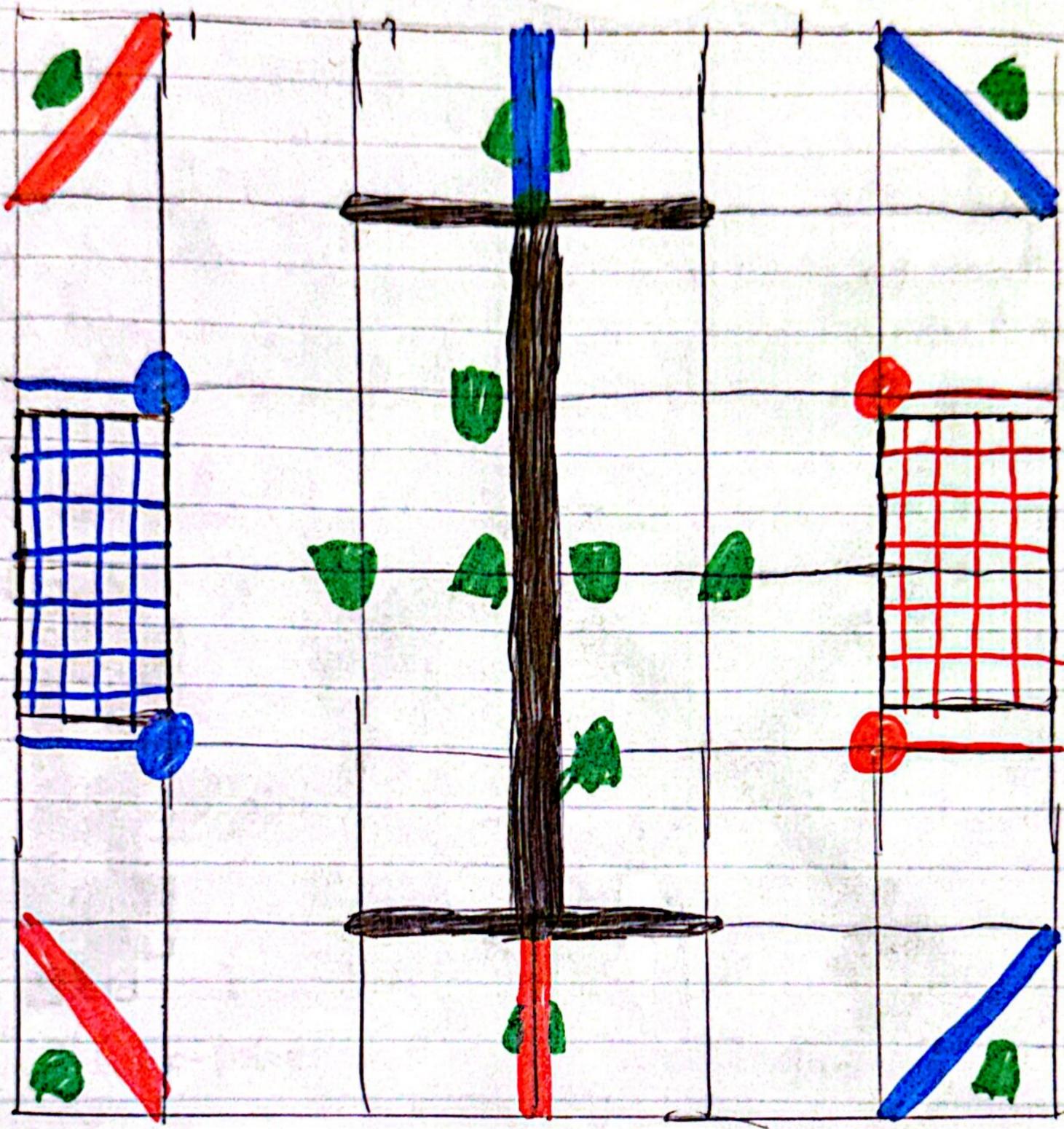
- Focus on match loads and goals
- Communicate with alliance
- Spend good time on elevation

### Defensive Strategies

- Stop team robots from match loading
- Avoid double-zoning
- If ~~low~~ on points enemy is low on points, block elevation

801112 internet

## Over Under Field & First Thoughts



### First thoughts:

- Very less triballs on field
- Black barrier is large
- Match load zones and goals are on opposite sides
- Triballs have a weird shape
- Triballs are very large
- Elevation bars are small and quite low
- Match load zones have a barrier

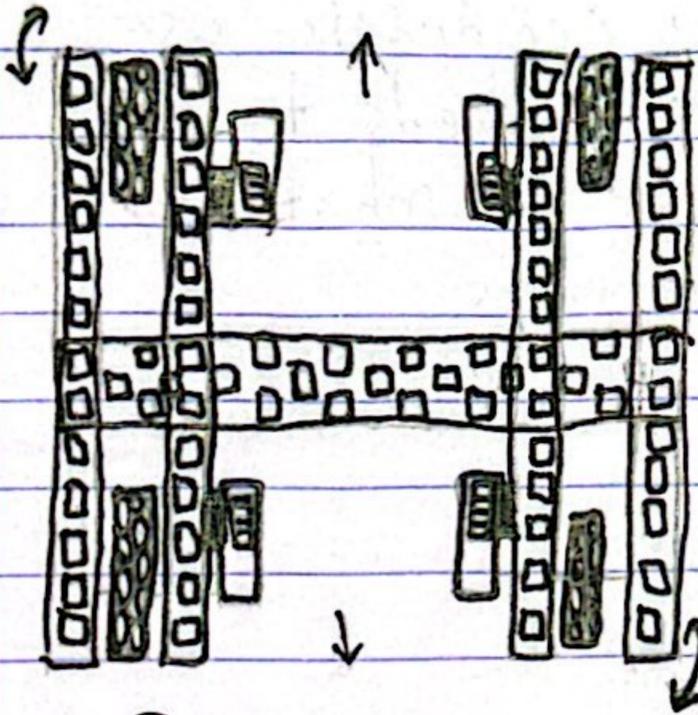
Friday 5/12/23

Building Session

Drivetrain Brainstorming

Our ideas for the drivetrain consists of 4 motors, and either tank or omni-directional. We want to have a tunnel for the green acorn to pass through, directly in the middle and almost touching the ground.

Option 1:



Tank-Drive

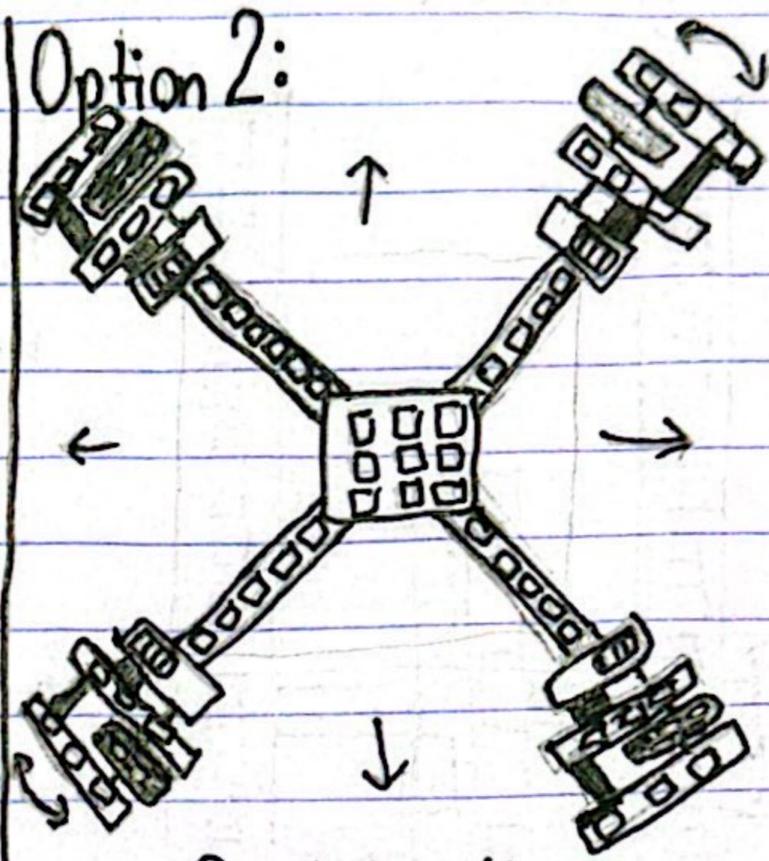
## Pros:

- Easy to make
- Clear path for tunnel
- Strong and stable

## Cons:

- Less movement ability
- Slow turning
- Weak center

Option 2:



Omni-Directional

## Pros:

- Great movement ability
- Faster and flexible
- Stronger turning speed

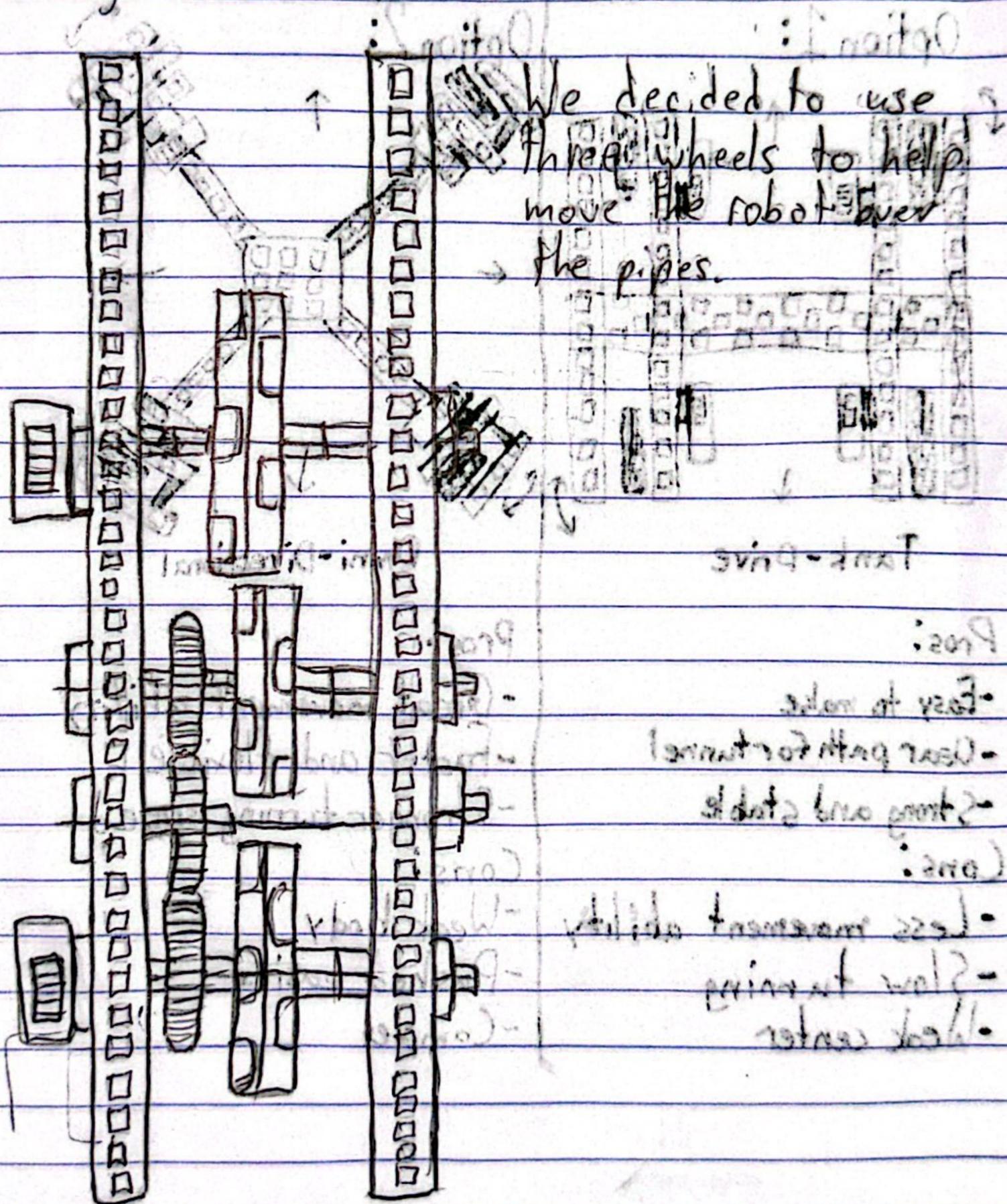
## Cons:

- Weak body
- Pushed easier
- Complex

Sunday 5/14/23 Building Session

After some thinking, we have decided to build the tank-drive drivetrain because it is unnecessary to build the omnidirectional and the tank drive can go over the bars.

After 2 hours we have made a prototype for the right side of the drivetrain.



We decided to use three wheels to help move the robot over the pipes.

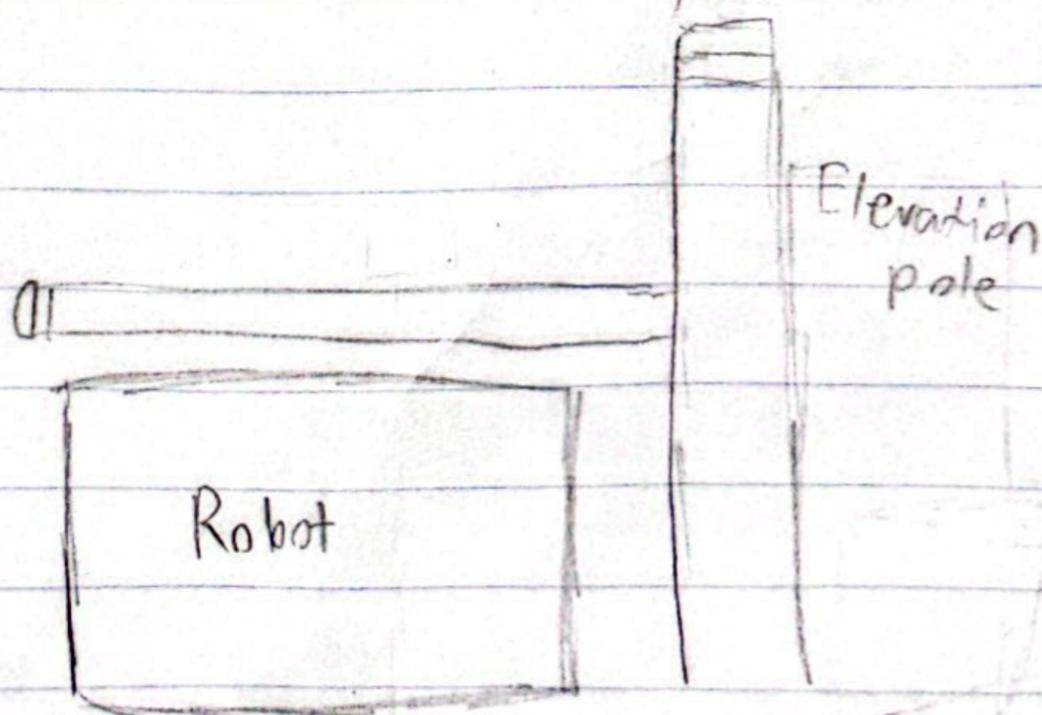
- Easy to make
- Gear both for travel
- Strong and stable
- Low maintenance ability
- Low friction
- Good center

Saturday 5/20/2023 Field Parts

Today we got parts for the 'Overlander Field' and we also got fri-balls to practice with. We are going to setup the field in the session today because we want to use it as another reference for our designs. Generally speaking, the field seems smaller than we would have expected, however generally we feel good about how our current design is.

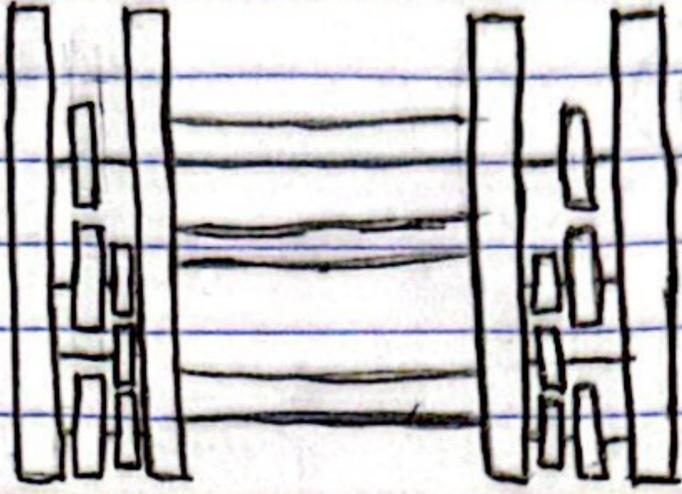
First Thoughts:

This is going to be really useful in general because we can practice out here, which gives us more time to prepare and we can also use it during the process of building as a reference. The elevation pole is one of the things that we noticed were smaller so it gave us a general idea of what we could do for elevation in the future.



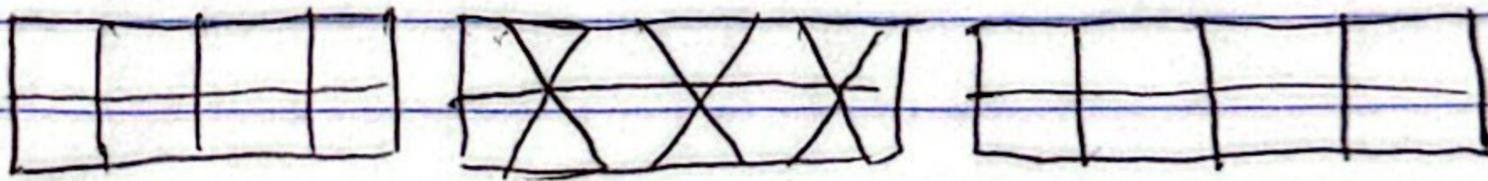
# Saturday 6/3 Building Session

We continued to update the 3-wheel drivetrain for our prototype:



After driving it around, we wanted our robot to either come to a complete halt while stopping or to let the wheels freely rotate.

We checked our code and our mechanics to solve this problem. After double-checking everything, we found out that it was also due to the six omni-wheels. To fix this, we put two regular wheels, one on each side of the drive-train.



omni-wheel

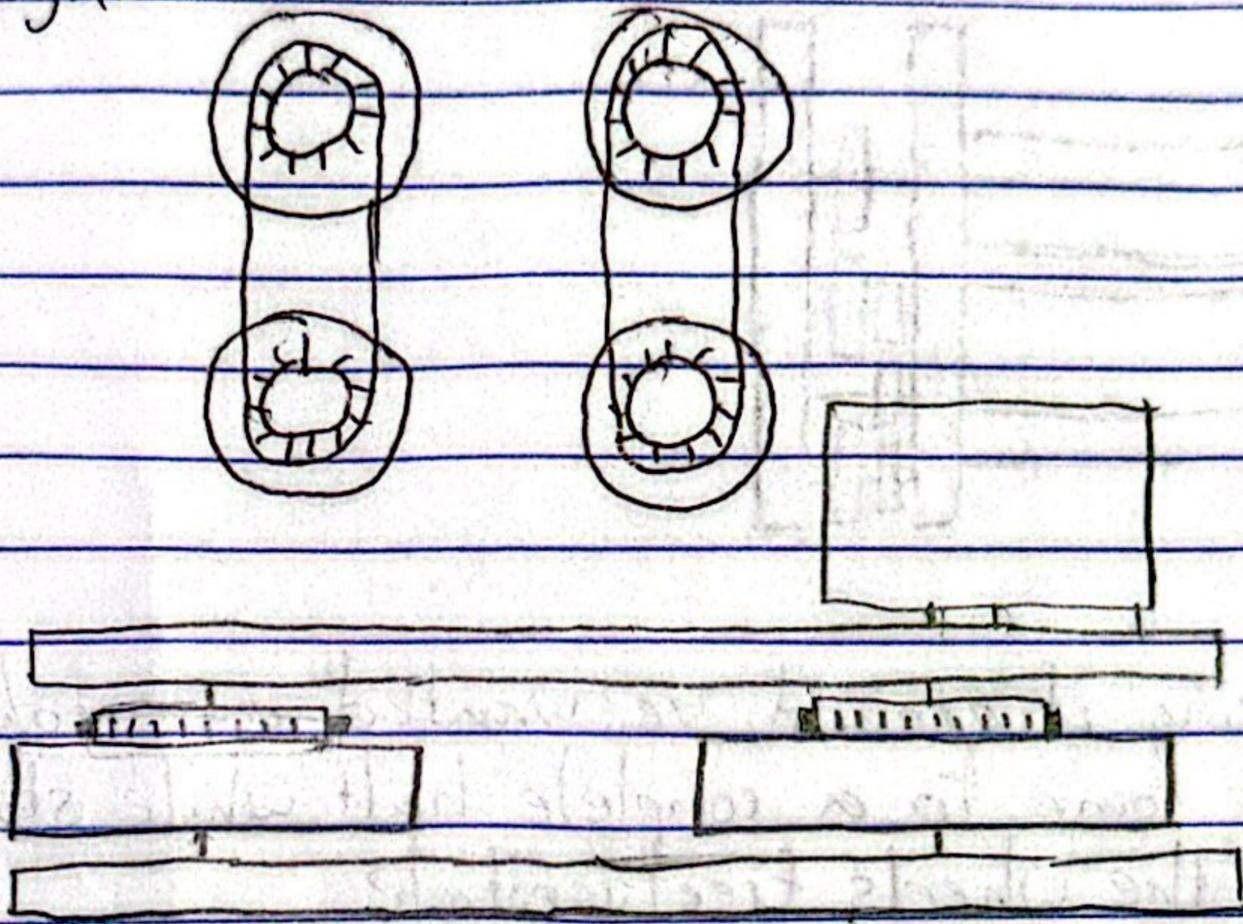
regular wheel

omni-wheel

Sunday 6/18

Brainstorming Session

The drivetrain is close to perfect. We will need to buy more parts for our intake design.

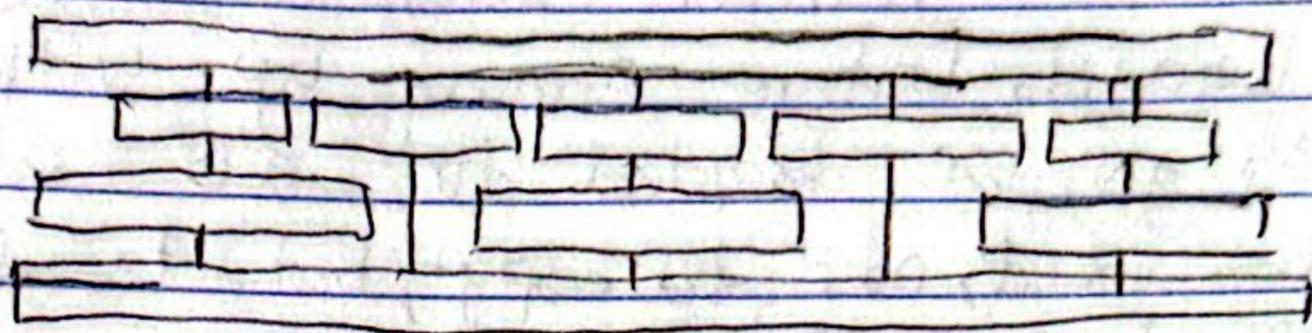


The design uses a flex wheel as the main way to intake. To power the flex wheels, we will use a motor on each side and chains to power the wheels. This design is useful as the design used in Spin-Up won't work due to the size of the tri-balls.

Friday 6/23

Building Session

On the wheel without a gear which was powered by a single motor, I put a gear as I planned to connect all of the wheels together with gears.



Unfortunately, we don't have enough gears to finish the build.

When tested the drivetrain out, I found out that the problem we thought we fixed was back, the infamous shifting of the drivetrain.

We researched and found out that the c-channel on the right side was being bent. So we removed some spacers and the drive train was fixed.

Sunday 6/25/23

Building session

We were struck with the harsh reality that ~~the~~ coming up with an intake, output, and general system for transporting "tri-balls" across the field would not be simple.

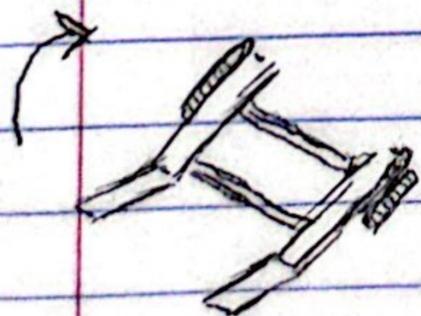
We decided to retreat back to the drawing boards. Before coming up with a final design, we decided to see what other teams did, not to copy, but to find commonalities between.

This is what we came up with:  
Components of VEX VRC Over Under robot.

- Intake (often used as output mech.)
- Launcher to transport tri-balls from one side of the field to another.
- Drivetrain
- Pole-climbing mechanism

We decided to start off with the launching mechanism. It had to be quick and powerful, and we narrowed it down to a few choices.

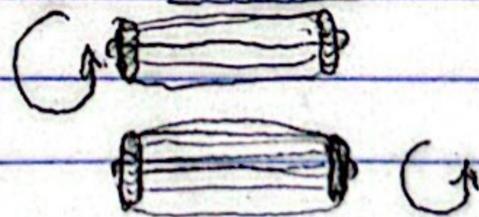
Catapult:



Puncher:



Roller:

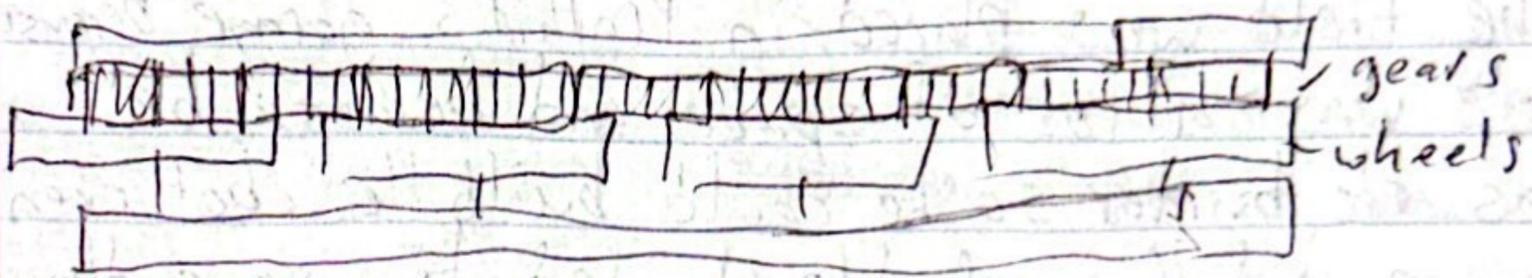


Preliminary decision: Rollers. They are a more cost-effective, fast way to shoot tri-balls to the far side of the field. They don't require pneumatics, more expensive than the motors that we already own.

Wednesday 7/5/23 Building Session

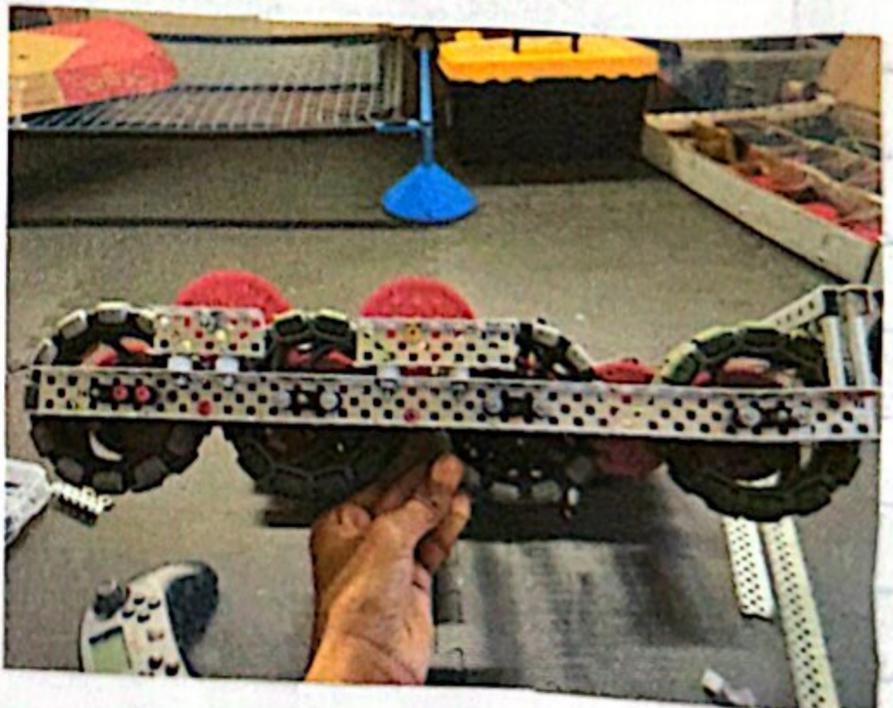
We decided to take a break on the intake and puncher and work on the drivetrain, and more specifically, how to get over the barrier.

To do this, we added a fourth wheel in the front which protruded in front of the c-channels



This allows us to move over the barrier with ease

New and improved  
Drivetrain



Friday 7-7-23 Organization

Today we built the field and organized our parts. We ordered around \$1000 worth of stuff including gears, sprockets, shafts, c-channels, etc. We made three large, white boxes, one for gears, wheels, sprockets, and chains, one for c-channels, and one for plexiglass. The little parts such as spacers went into the toolboxes, and the tools and electronics went into a separate box.

The field was placed in Prathit's garage because there was a lot of space and because he was the builder, so he could build the robot even if we didn't meet. We decided to use cardboard for the walls because the field perimeter was really expensive and because we had a lot of extra cardboard from the shipments.

This took the entire day so we didn't have time to do any work with the robot.

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Monday

~~6/23~~

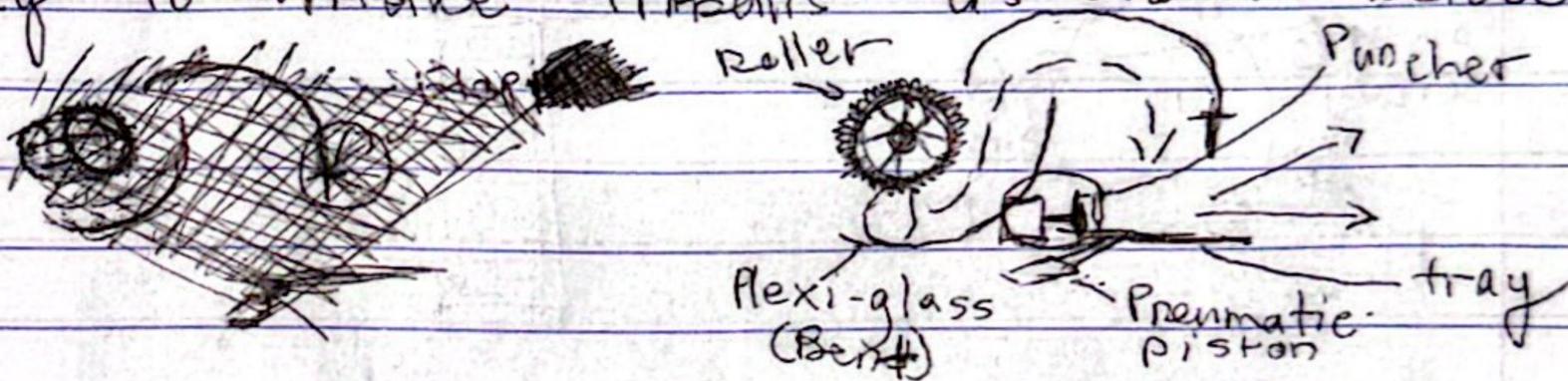
Building session

Today, we wanted to focus on the intake ~~input~~ mechanism, and how everything we brainstormed for the robot would flow together

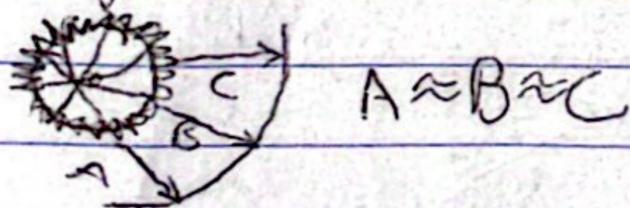
\*Side Note: Upon further discussion, we decided to make a puncher that would be faster than our previous conceptualized version.\*

Intake Robot design

We decided to make the Roller design our robot's intake. We ~~made~~ designed an efficient way to intake triballs as shown below:



Breakdown: The roller (placed slightly before poly-carbonate) will be placed almost equidistant from all points of poly carbonate.

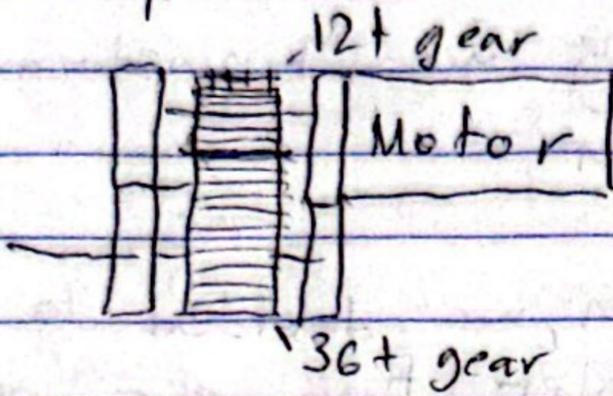


The game-piece should go through the intake and drop into

8-4-23 - Puncher Finished

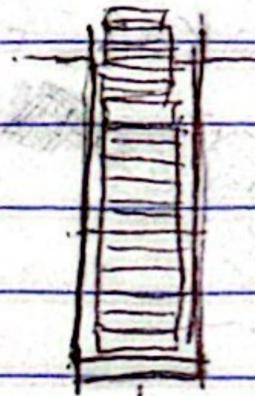
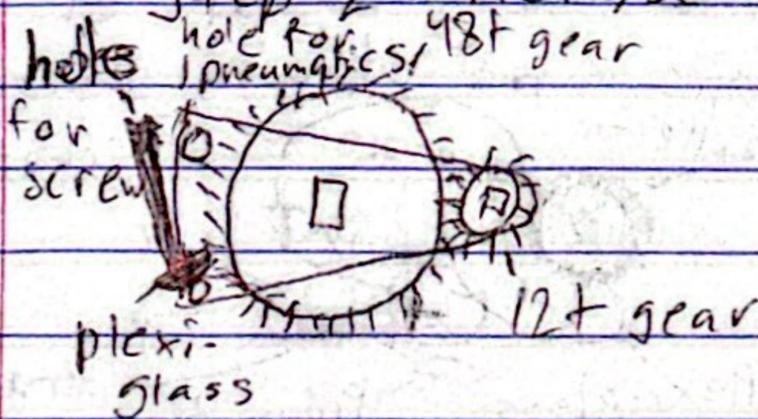
## Steps for building the Puncher

Step 1: Gear box



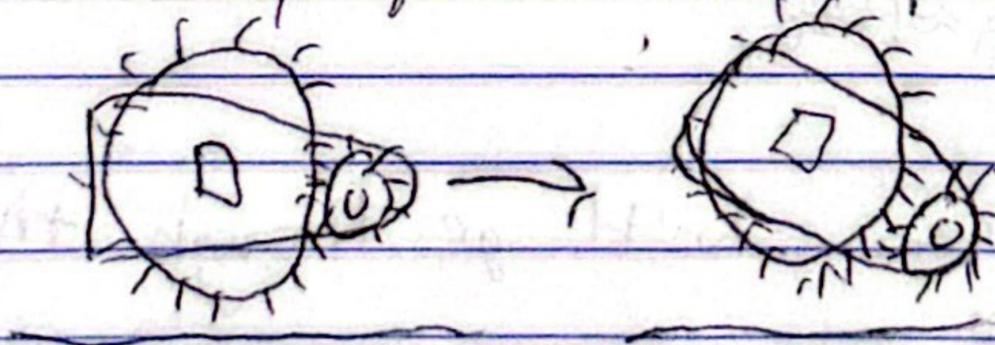
Since the motor's use will be to pull back the puncher, it doesn't need to move fast. Also, using a stronger gear will help to not put strain to the motor.

Step 2: Release mechanism



standoff

The pneumatics pistons (two of them) will be attached at the top hole which is labeled. The entire piece will lift off with the 12t gear staying in the same position.

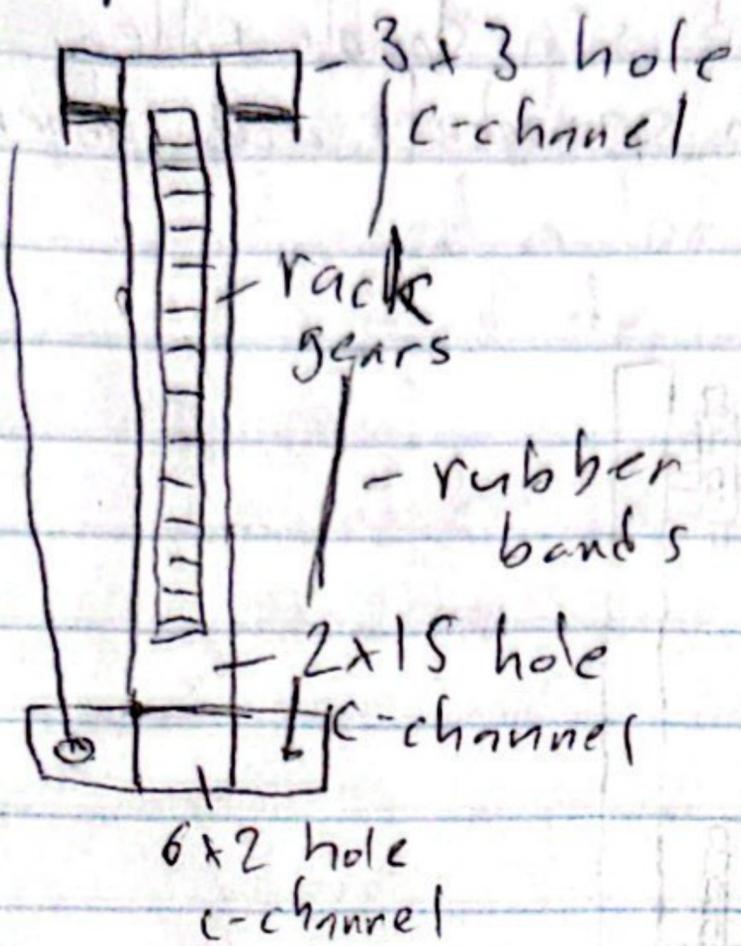


This will release the puncher arm

# 8-4-23 - Puncher Finished

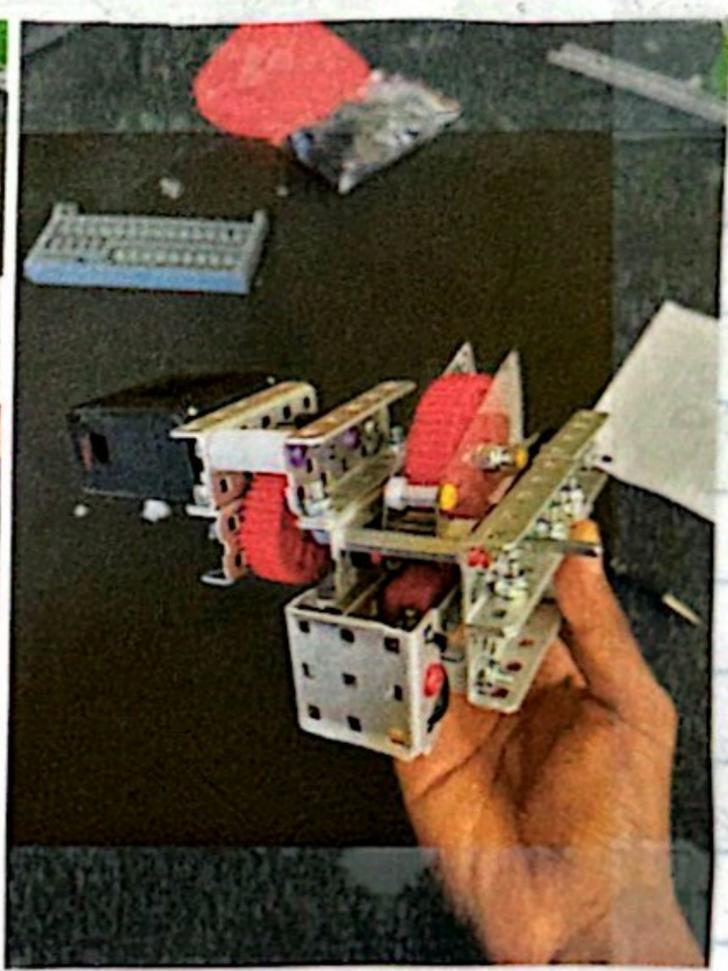
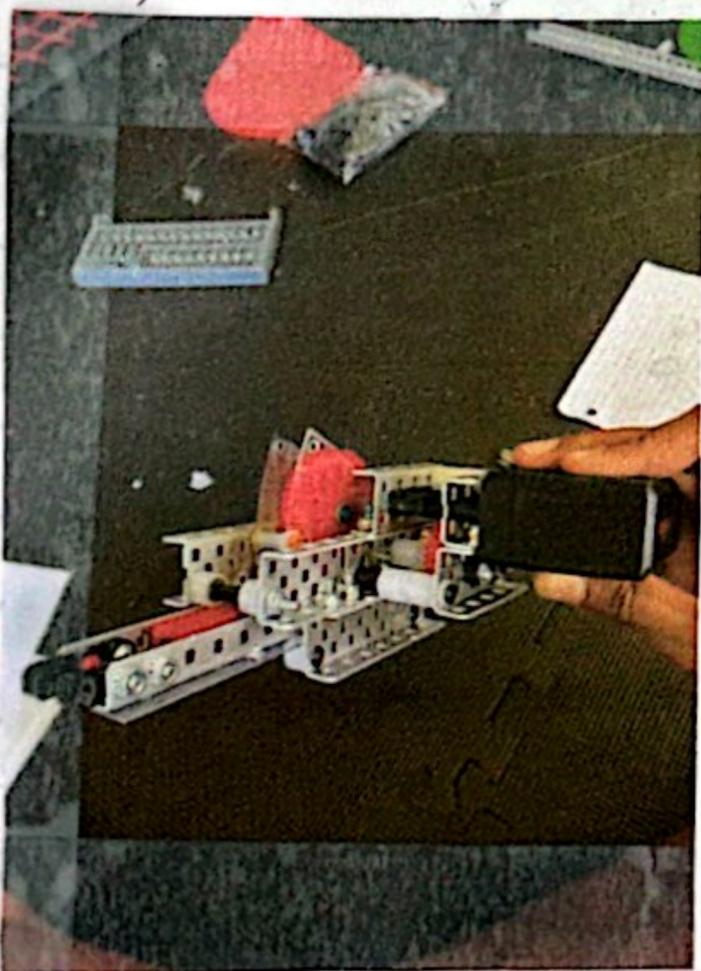
Steps for building the Puncher pg. 2

Step 3: Puncher arm



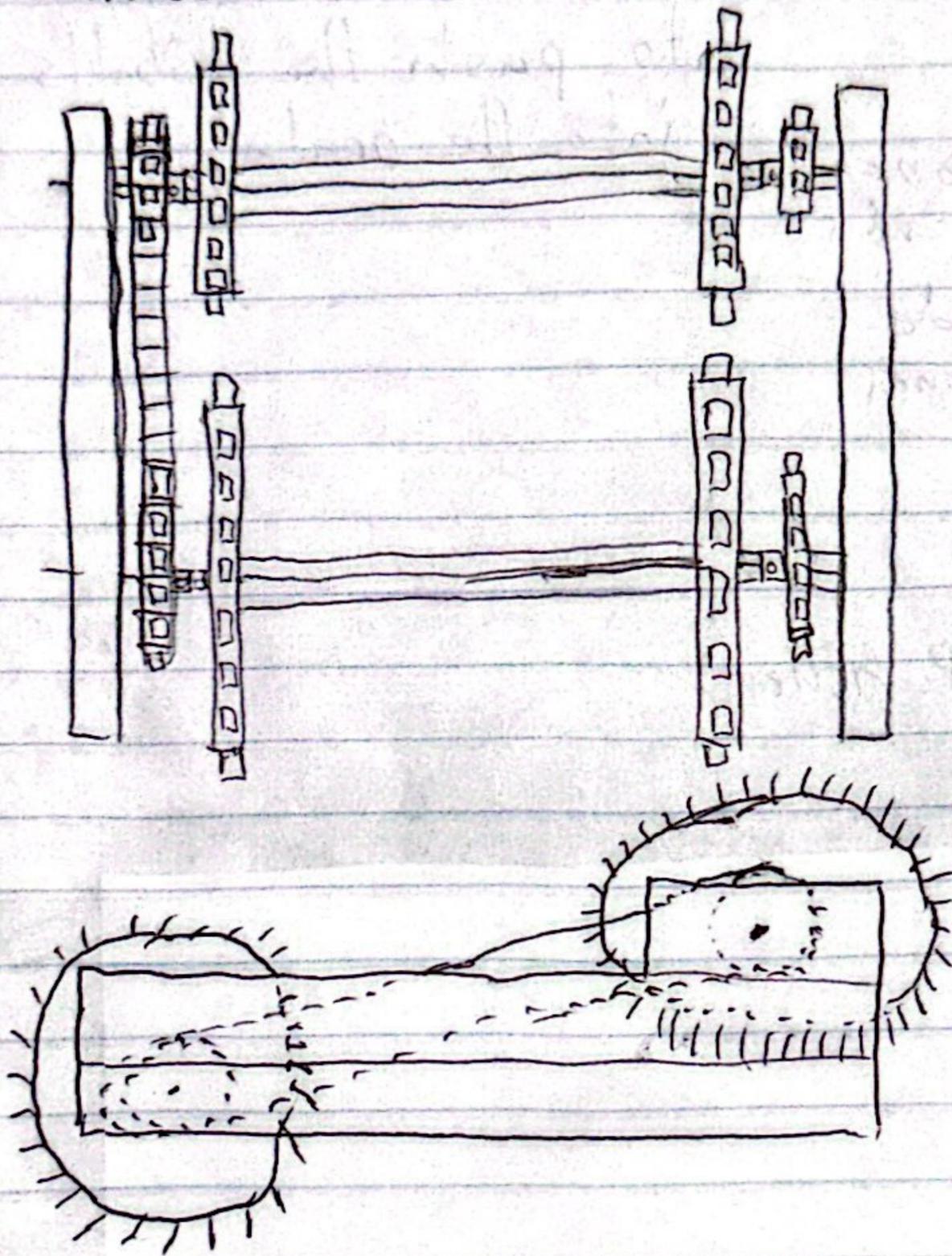
The puncher arm will be the thing to push the triballs into the goal.

Completed Puncher:



8-6-23 Sunday Design Session

We're now going to move on to our intake. The design we have in mind is a double roller with the rollers made with sprockets and rubber bands.



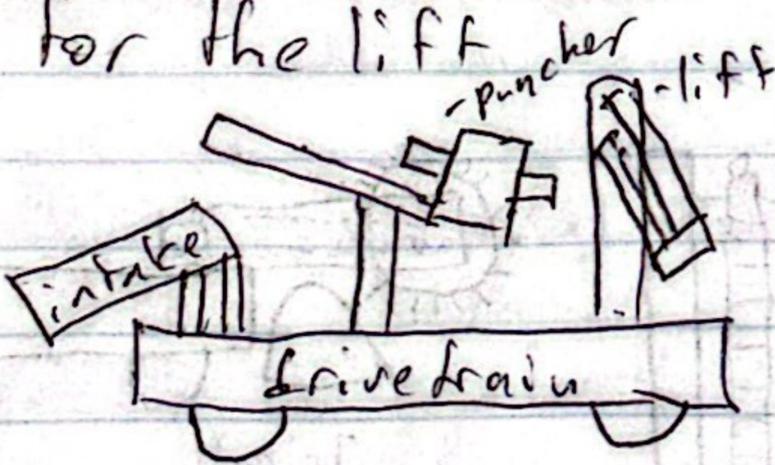
One flaw with the design is that each roller requires a lot of spacers. Otherwise, it is really effective.

## 8/12/23 Saturday Design Session

After a lot of debating, we decided to scrap our puncher design. Some reasons we did this was because:

1. It used a lot of pneumatics
2. A lot of teams just pushed triballs in the goal
3. An intake can push ~~it~~ triballs in a goal very effectively
4. A one motor lift was impossible, so we need to scrap our design to use its motor on the lift

We did research and found that having a linear punch shooting in the same direction of the intake was best because it could shoot fast for watchloads and it left room in the back for the lift



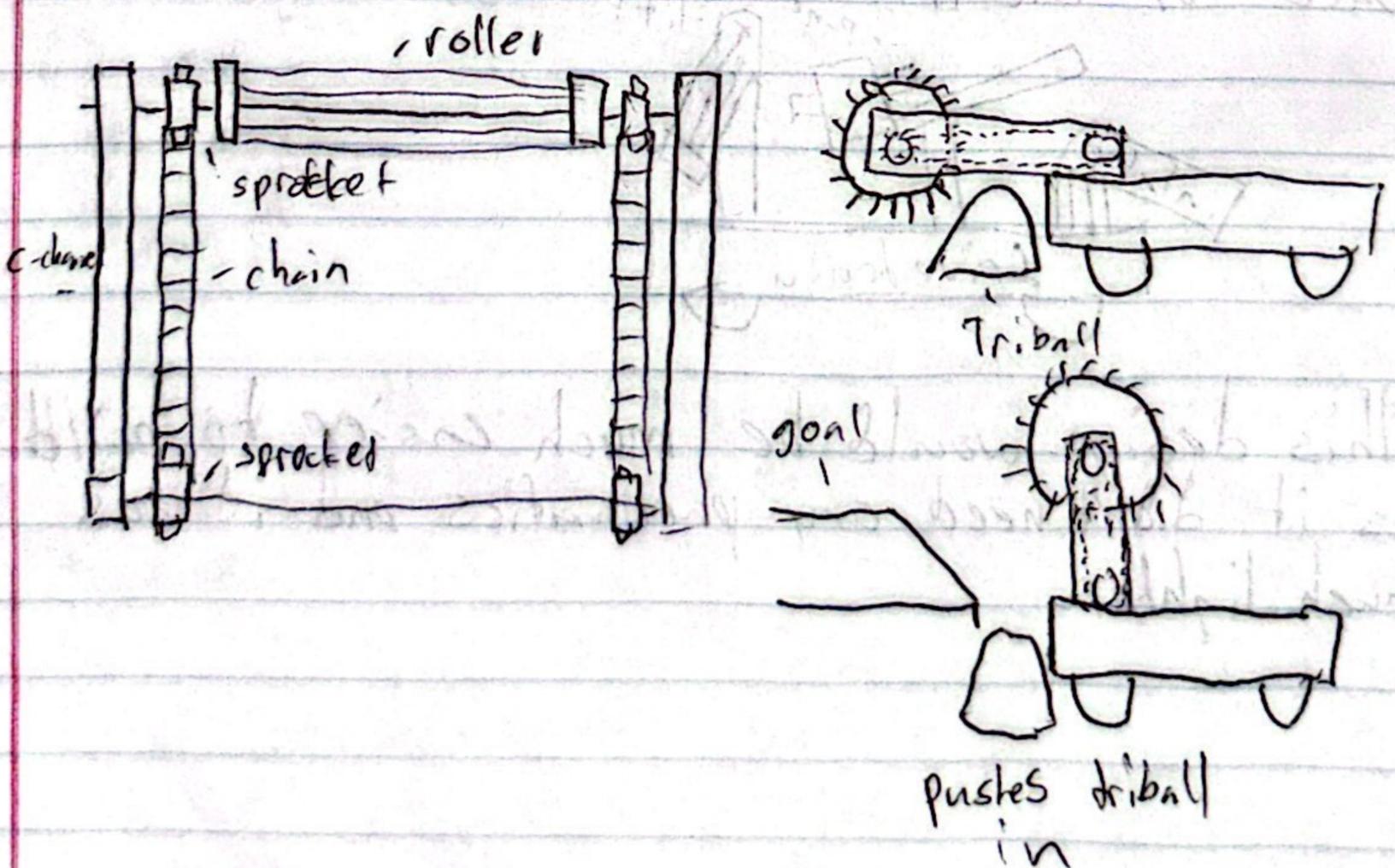
This design would be much easier to build as it didn't need any pneumatics and it was much lighter.

8/13/23 Sunday Design Session

In order for the puncher to shoot in the same direction as the intake, the intake has to be changed because the triballs won't be able to shoot over it.

We decided to use the intake 2775V used in MOA because it was able to ~~shoot~~ score triballs in the goal easily and it was small.

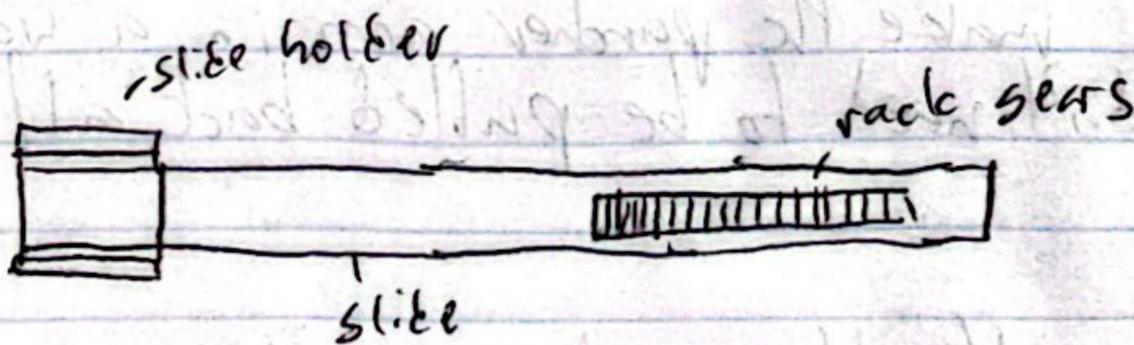
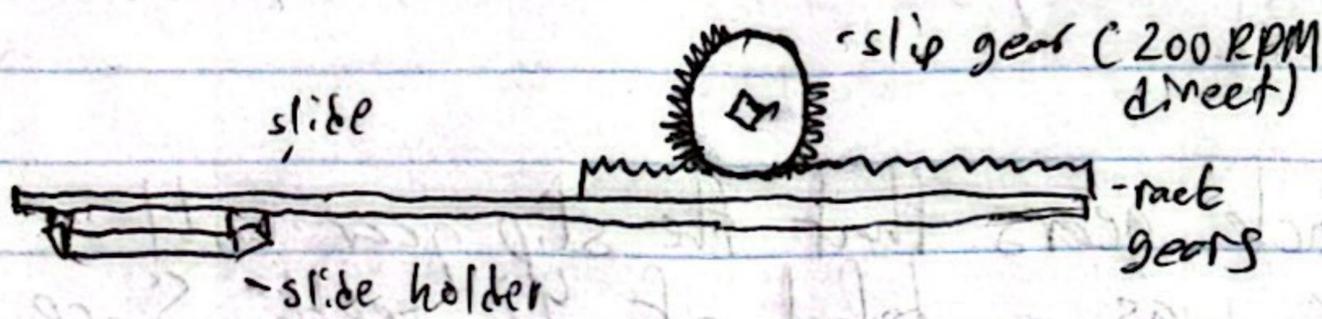
It was a single roller that was connected by two c-channels. The roller could lift up using a chain lift. A chain lift basically uses chains to wrap around a sprocket, so the chains can move in a  $360^\circ$  circle without disconnecting.



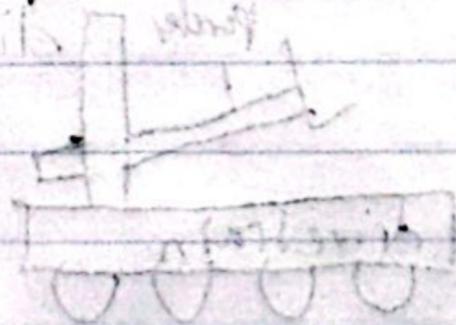
## 8/13/23 Sunday Design Session

The puncher for matchloads is going to be a linear puncher because it is fast and doesn't require high strength axels.

The puncher uses the linear slides, rack gears, and a 36t slip gear.



One flaw with the linear slide is that it is very large in width. If we want the lift to be behind the puncher, the puncher will have to go through the lift.



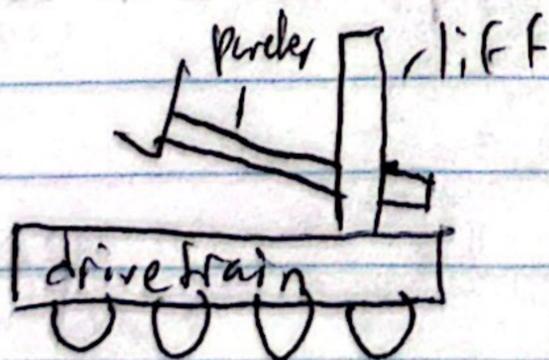
8/19/23 Saturday Build Session

We decided to start with the puncher as it would require the most amount of time.

To make a slip gear, you have to shave down teeth. Most teams use machines, but we don't have any so we used a file. We started by shaving 6 teeth and seeing if it would work.

The rack gears that the slip gear will pull back was a total of 40 teeth. Since ~~our~~ slip gear was originally a 36T gear, we had to make the puncher arm in a way that it didn't need to be pulled back all the way.

One flaw with the puncher is it is very long, around half the length of the robot. For us to put a hanging lift in the back, the puncher would need to go through the lift.

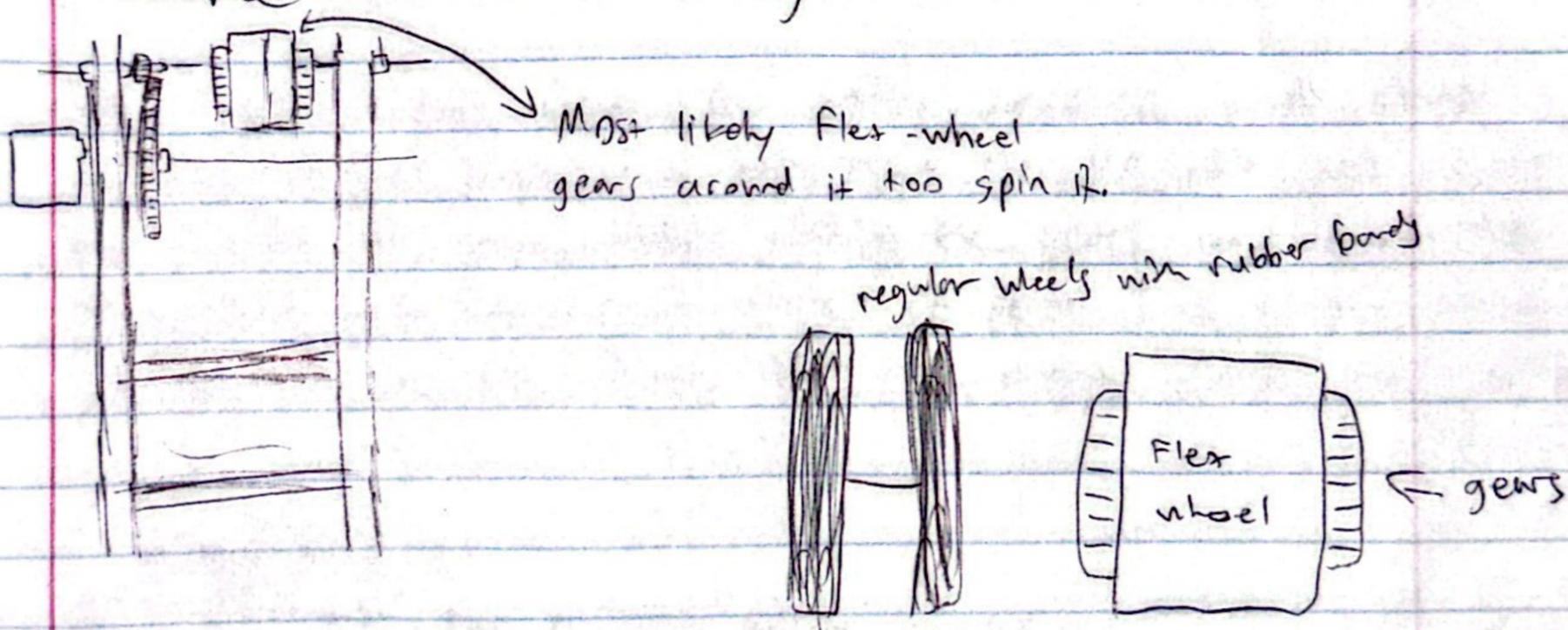


9/2/2023

Saturday

Design Session ~~with the charges~~

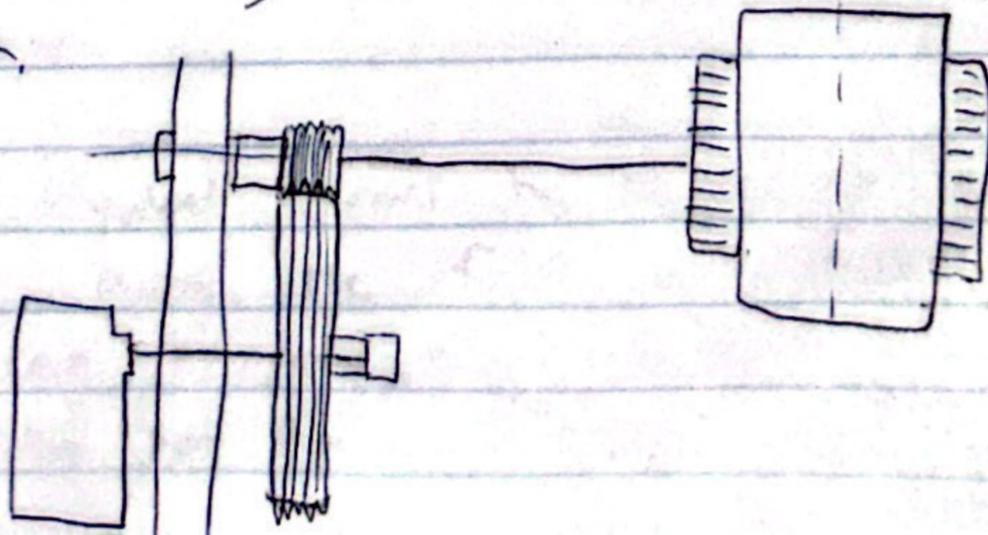
We realized that the puncher that we had before to push the tri-ball to the other side of the field was not powerful enough to do this well. We instead thought of creating a flywheel type of design that flings the ~~flywheel~~ tri-ball across the field instead of pushing it. This would make for a more power and more reliability <sup>launching mech</sup> since gravity is a bigger factor than if we used the puncher where we needed to hold it. We are going to prop it up with two C-channels so that it would travel a longer distance before reaching the floor.



First thoughts:

We need to make the flex-wheel connect to two gears on both sides so that it can spin as the flex wheel has no shaft spinning.

The motor will most likely be below the flywheel so we can take advantage of gear ratios and have a big gear more a smaller gear that is attached to the shaft with the roller.



9/17/2023 Sunday

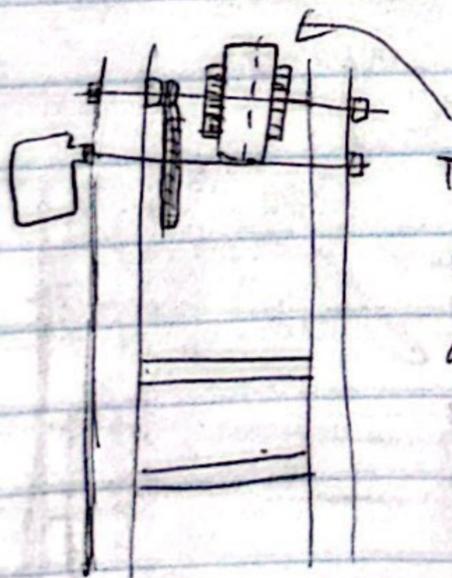
## Building Session - Flywheel Update

Today we are going to build the flywheel to replace the punchers. We already have the rough design and some knowledge about building flywheels from last year so we predict a smooth process just like our ~~roller~~ <sup>intake</sup> re-design.

### Challenges:

One challenge we had was that the roller kept slowing down, because there was too much friction. This is an issue that can be really bad as the speed of the roller heavily relies on a frictionless plane to rotate.

We resolved this issue by adding spacers and shaft collars with our original justification being that the unstable axis caused the shaft to move shakily making the gears and ultimately the flywheel gets intervened while it spins. This theory turned out to work as the issue for the most part got fixed.



The finished roller matches our original design with the two gears on both sides to provide a spinning axis.

### Final thoughts:

Overall the flywheel seems to be functioning well and it transports the tri-balls across the field more evenly. An issue that we can see happening is the friction thing coming back on our flywheel not ~~be~~ having enough grip.

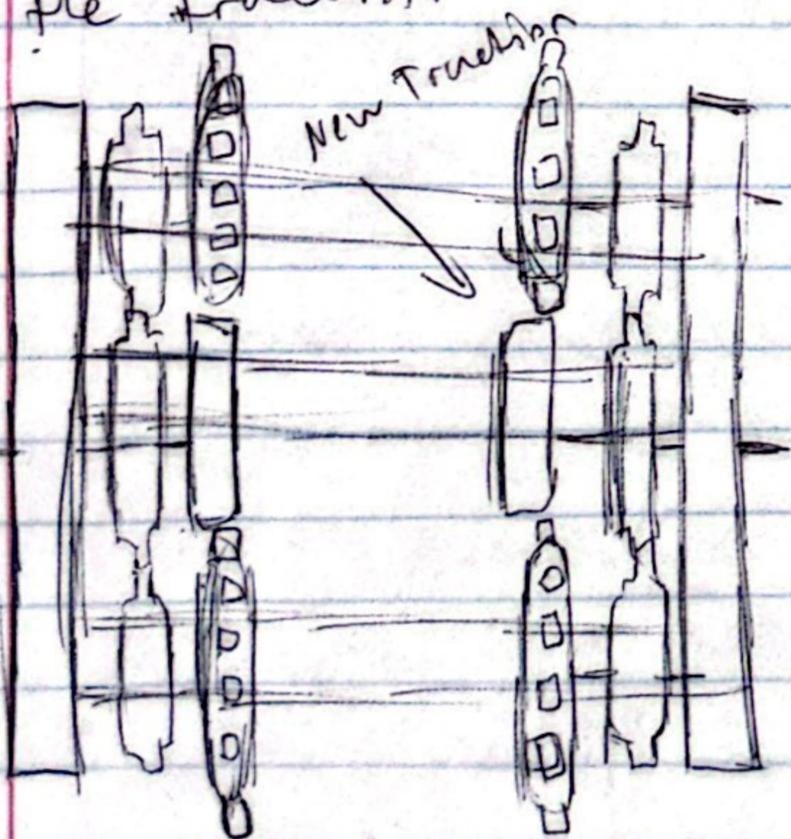
## 10/7/2023 Saturday Drivetrain Changes Needed

We noticed that our drivetrain from earlier was not gaining enough traction. From experience we know that this is an issue because opposing robots push us around, which is a disadvantage of having omni-wheels. We decided to use traction wheels for the middle wheel in our drivetrain as it would in theory keep our robots mobility with the omni-wheels while also providing stability.

First thoughts!

Not a hard process per say as we need to only replace the current middle omni-wheel with a traction, so it would deal any complications in theory.

The middle gear that we planned to use for the omni-wheel would not have any issues with the new addition of the traction



Traction wheels are currently not in stock on the sources we use, so we will temporarily keep our omni-wheel design and we predict the swapout to not be very complicated.

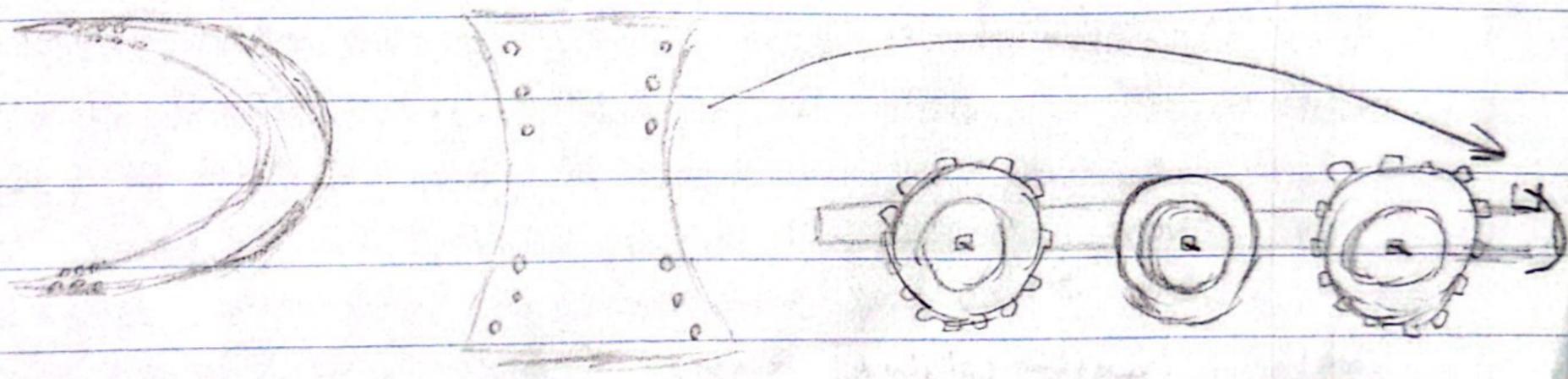
10/15/2023 Sunday

Building session - Drive train Update

Today

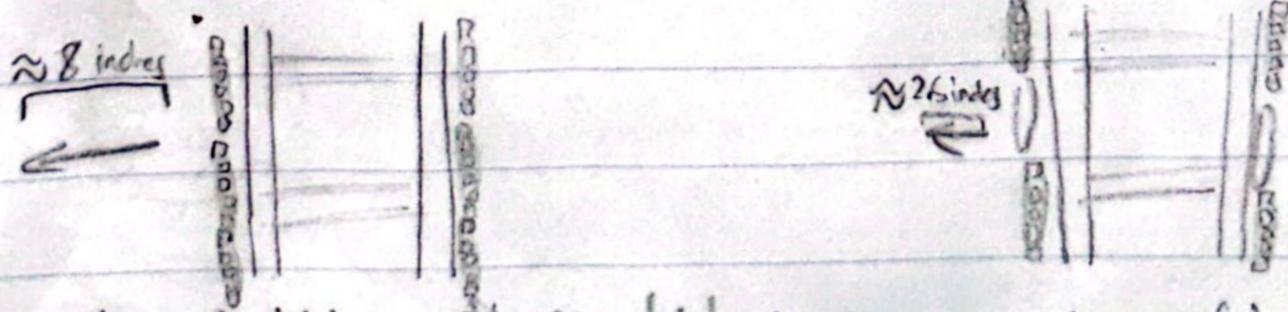
Today we made some updates to the drivetrain design.

Firstly we added sleds made from polycarbonate to the front of the drivetrain, because it lets us cross the boundary in the middle more easily and it would help with mobility. We are most likely going to zip-tie the sleds so that we can easily access them and they are less constrained as they would've been with screws so that they would cross the boundary with ease. Secondly we got the traction wheels today and we replaced the omni-wheels in the middle with them.



First thoughts:

The robot definitely feels much more stable with the traction wheels and the sled made the robot glide much more easily across the perimeter of the field. We did a test before and after the traction wheel replacements.

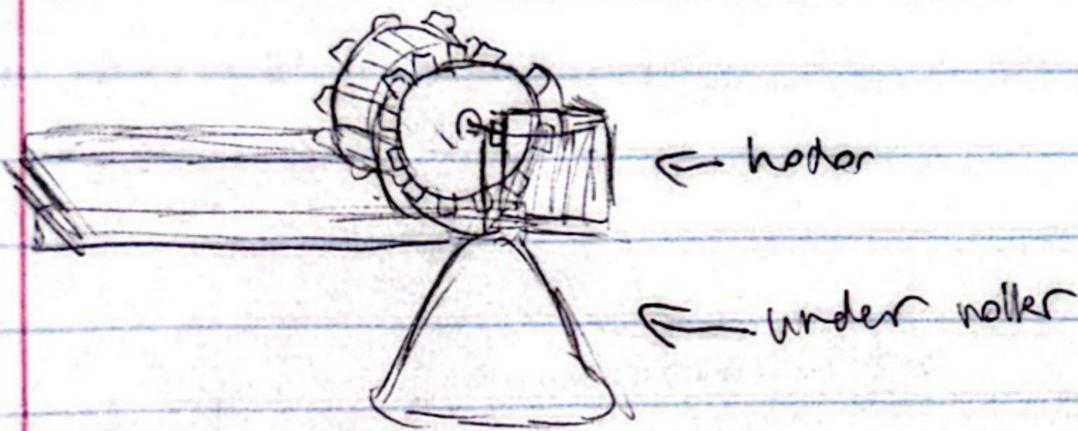


Overall we think that this was a really big change for the tournament as this year it seems to be a lot about mobility.

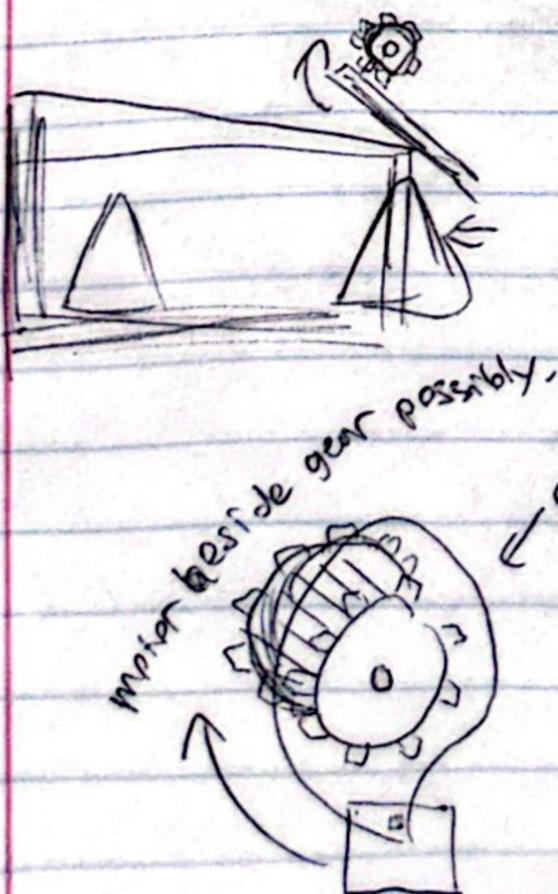
10/29/2023 Sunday

Design Session - Intake Update

We made some changes to the design of our current intake. We are planning to keep the current shape of our intake however we realized that a more efficient way of storing our tri/balls with the intake would be to keep it right under.



This would make for a quick release if we keep the c-channels bounding the drive train and intake loosely bounded so it can move up and the constraint the movement with rubber bands so it won't go too far back. This would let us just jam our robot into the goal so the intake would slide up and the tri-ball would quick release into the goal.



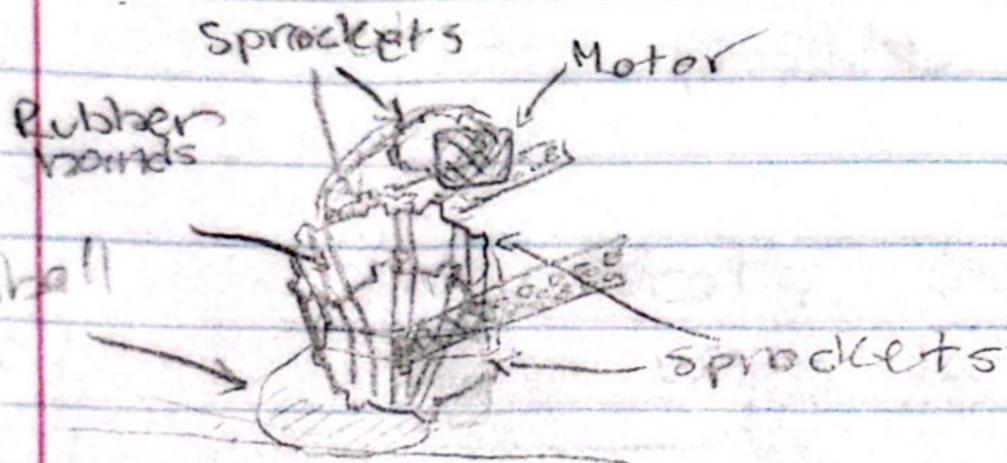
First Thoughts:

We need to minimize the actual mobility device to just the roller and some rubber bands to move the triball into this compartment as it spins. We would then ~~need to keep~~ only need one chain and that's the one connecting our motor and spinning gear. Most of the work would be on one side of the intake which doesn't seem like an issue though as we could make it.

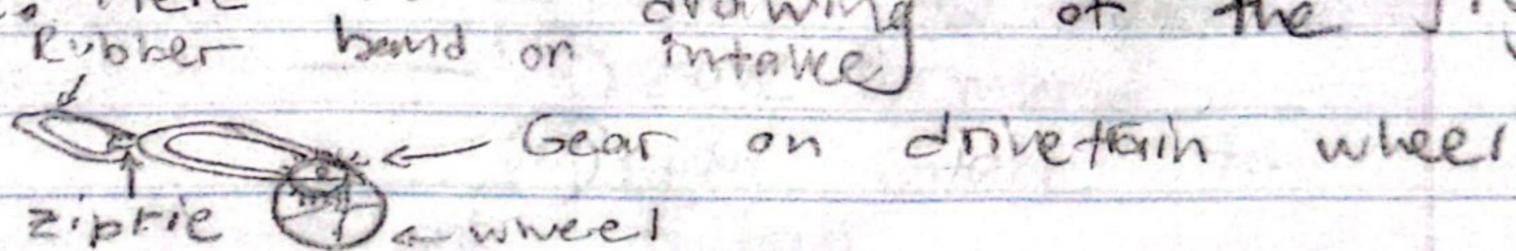
11/11/2023, Saturday

## Building Session - Intake Update

Today, we finished the construction of our intake. We wrapped rubber bands around sprockets to create a cylinder that would grasp the triball. Here is a drawing of the intake:



As we constructed the intake, we noticed that mounting the intake on our robot would exceed the size limit. To fix this, we decided to make a jig that would hold the intake up before we drove. Here is a drawing of the jig:



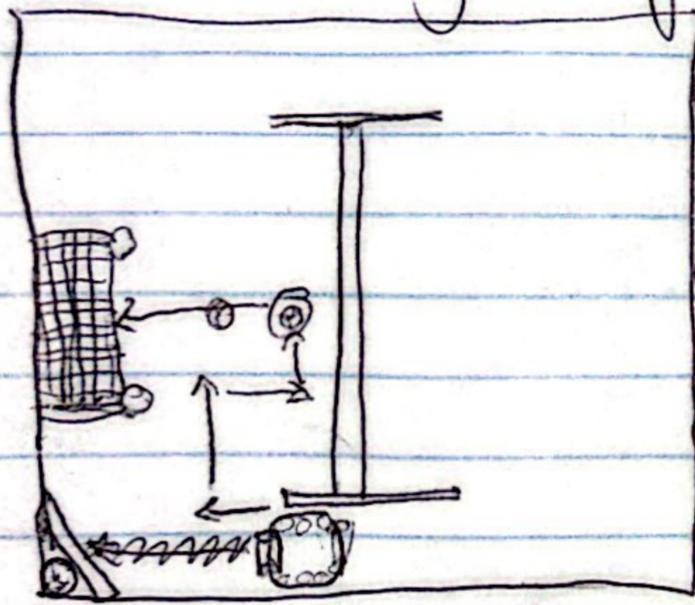
We are worried that the weight on one side of the intake (caused by motor), would eventually hinder the intake's ability to intake the triball. Luckily, this has not happened yet, and we will pursue a method to resolve this.

# 12/9/23 Autonomous Coding (Programming Session)

We wanted to get an autonomous win point originally, but soon reverted the decision with the realization that our robot couldn't perform the given tasks.

Instead, we opted to get the most points ~~as~~ possible during the autonomous period.

From our robot's capabilities, we deduced the following ways to score points:



- ① move forward
- ② rotate  $90^\circ$  right
- ③ move forward
- ④ rotate  $90^\circ$  right
- ⑤ move forward
- ⑥ rotate  $90^\circ$  ~~right~~ left
- ⑦ move forward
- ⑧ spin intake to collect triball
- ⑨ rotate  $90^\circ$  right
- ⑩ ~~the~~ move forward

Net Gain: 10 points

(will push one triball while releasing another triball in captivity.)

came up with we ~~draw~~ the same ~~time~~ plan because we forgot the fact that we could preload! This time after step ⑧ we would try to get the preload in and would continue to abide by the plan.

Net gain: 15 points

## Sunday 12/17/23 Tournament Analysis

We went to a tournament on the 16th. Our robot didn't perform the best along with us not driving the best.

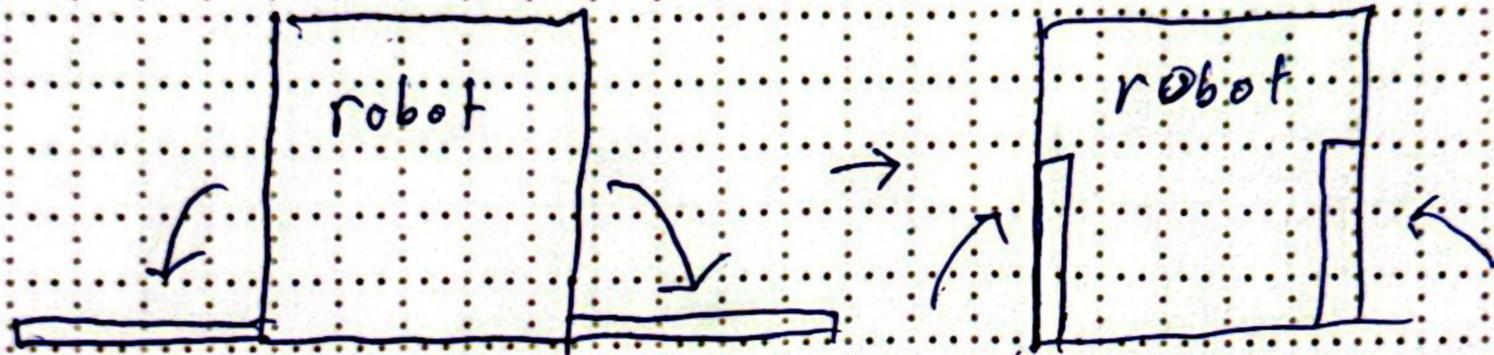
### Problems:

- flywheel wasn't reliable and was breaking
- Robot was too light at the base and was too tall
- Autonomous wasn't working; most times it did something else

### Solutions:

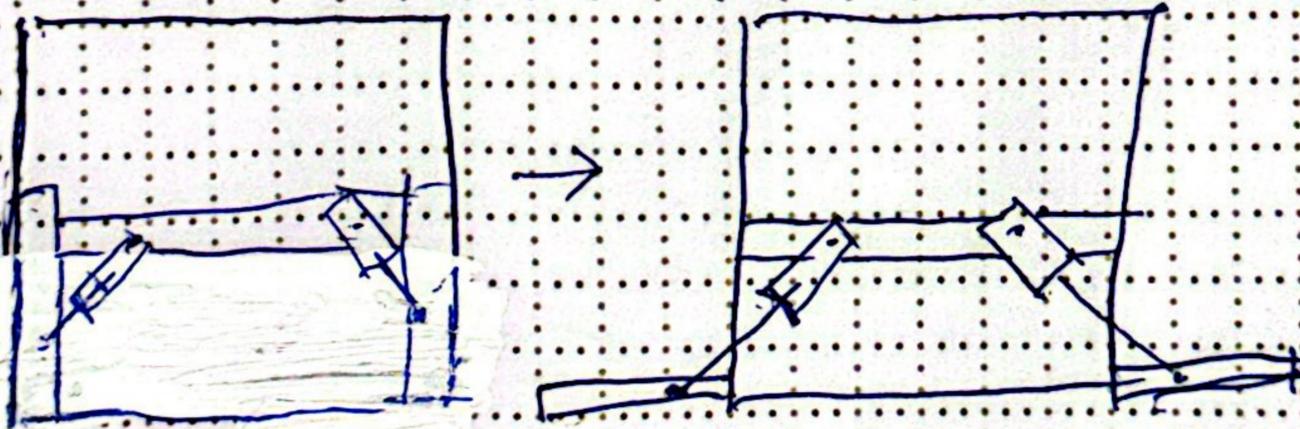
- We will build a catapult with high strength axels so it won't break
- We will keep more weight at the base and decrease the height of the robot
- Switch the brain with a new one and make sure the auto is safe with no places for mistakes

Another component we wanted to add to our robot are wings. Wings are pieces of c-channel that extend out of the front or back of the robot to help push triballs into the goal.



The wings (each) use one pneumatic piston.

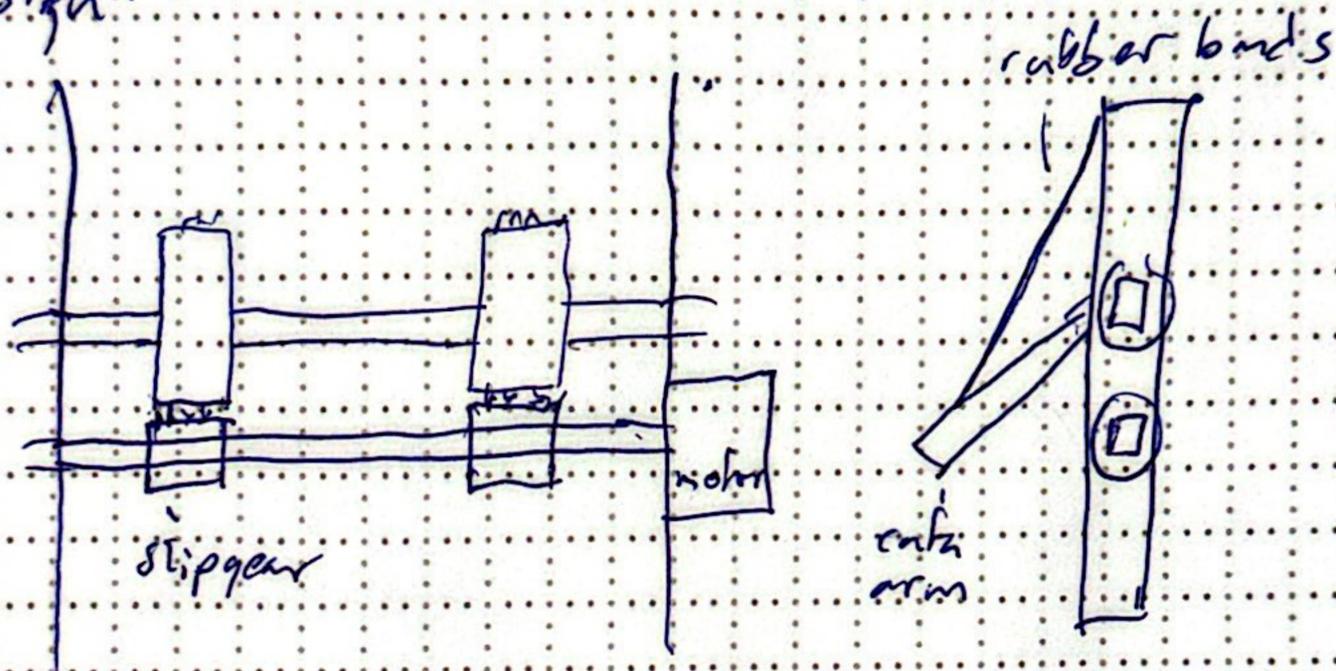
Design:



The wings are going to be at the back of the robot since the sleds at the front of the robot are taking up space.

After seeing what some other robot's matchloading system, we decided that we needed to make a catapult since it was more reliable and it didn't need to be super tall.

Design:



The slip gears pull the catapult arm back, but when the flat part of the slip gear is in contact with the gear of the catapult arm, the catapult arm is pulled by the rubber bands.

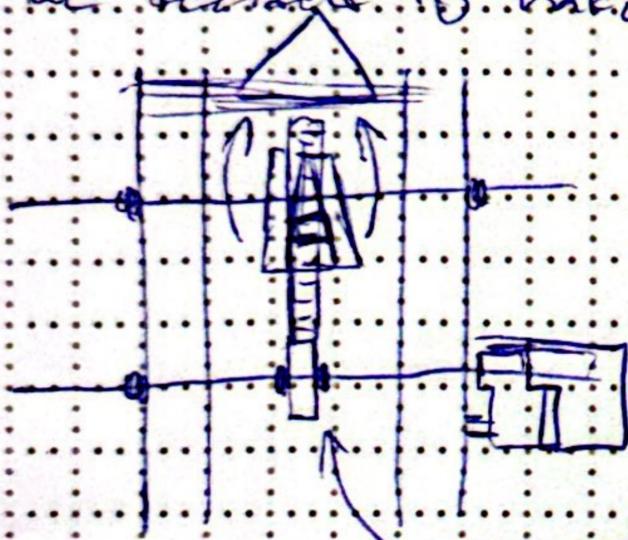
Saturday 12/27/2023

Build Session (aka Design + Build Session) Purcher

Issues we ran into after building catapult:

- Entire catapult was too tall
- Wasn't strong enough
- Sometimes it didn't even shoot

Because our next tournament was only a week away, we decided to make a simple trick shooter.



slip gear

When the flat side touches the other gear, rubber bands will propel the trick shooter up as it is no longer manipulated by the motor

This design is going to work better than the catapult since it is

We built the catapult, but there was an issue ~~with the~~ as mentioned earlier, but overall the building went as expected. We do wish that we had designed it more reliably looking back.

Overall we think the trick shooter will perform better than the catapult we had and more reliably as we have tested.

Project

Name

Date

VEX  
ROBOTICS

PROPRIETARY INFORMATION

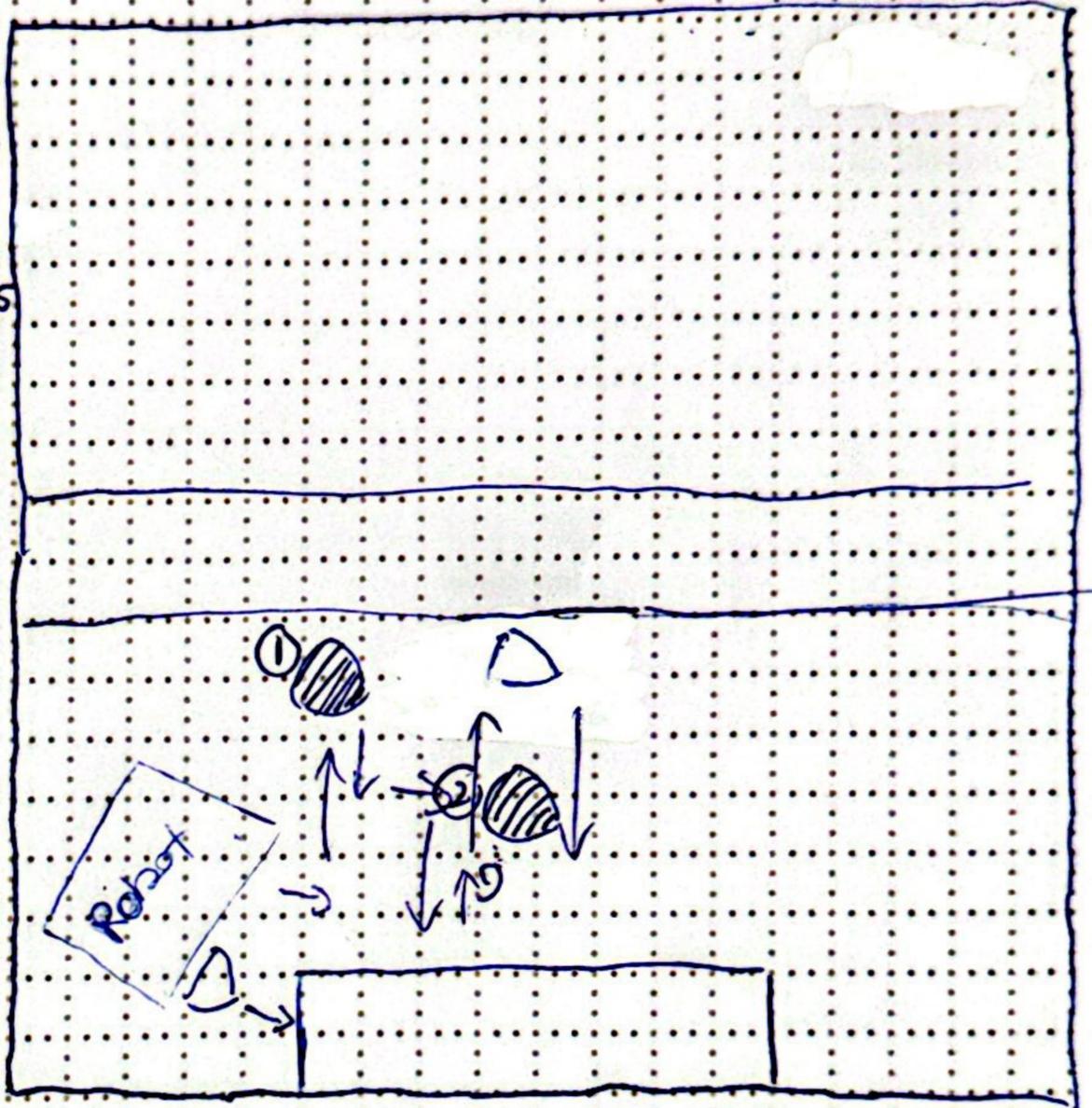
1/5/2024 Friday

Autonomous Coding

We wanted to make a new autonomous program that utilized our new ~~but~~ pneumatic wings. Below was our plan:

- Push matchload into goal
- Turn and go forwards to pick up triball ①
- activate wing and shove robot into goal with triball

Our auton. plan seems to be working fine, but the issues and hypothetical issues that we have or may have are with positioning and crossing the boundary.



### Positioning:

Every time we position the robot, it is not the same so the results vary, so sometimes it works and sometimes it doesn't. We can fix this by making a clear chart for the position.

### Crossing Boundary:

Sometimes during the 3rd stage which is when we get the second tri-ball our robot crosses the boundary, which cannot happen so we can maybe move it less, so it reduces the chances of this.

Project

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Plan:

- Anton
- Wings
- ~~Stabilize~~ Puncher } check
- Practice

1. Anton

2. Wings

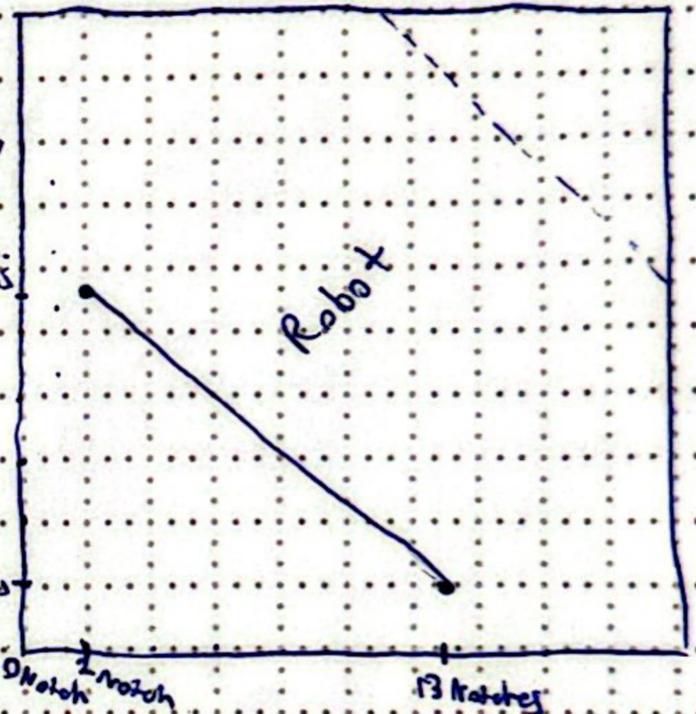
3. ~~Stabilize~~ Puncher } check

4. Practice ← sleds and Pristrals

Anton:

We are thinking about creating the position of the robot first so while the robot performs the first stage of auton, the red pole from the goal does not obstruct the wheel as it goes forward, or the wall on the field.

The position we are thinking about is 18 notches on the tile horizontally and the 2 notches up and then vertically 11 notches and then 2 notches to the right.

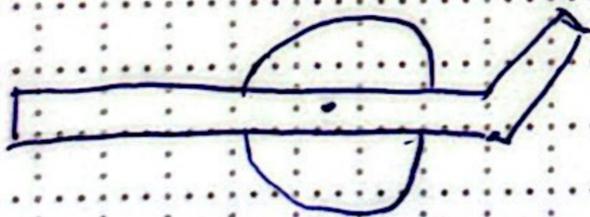


The battery is out, so we need to work on other things. 11 notches

Challenges:

While we were testing auton, our sleds broke so for the time being we are going to build another after stabilizing punter.

For the future we are going to make a ramp like design.



We realized our drivetrain was at an angle so we plan to adjust the channel and we hypothesize that it will fix our drifting issue.



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Overall auton works fine and we adjusted the angles and some distances to accommodate. We realized that the angle we want is always 180 more than the code so when we turn 90° we program it to turn 70°

Check:

We made sure the wings were looser than tighter as we know that it performs better due to the lack of friction

The punter works as intended with no issues as at right now

## Drive train:

Our drive train as we tested work sufficiently for the tournament tomorrow even though there is some drift, but since our tournament is so nearby we don't want to do anything drastic that might make it worse.

For the future we are planning to add a spacer, that was not there for one wheel, between the c-channel and wheel and then adjust the c-channel with the other c-channel holding the left and right drive train together.

## Sleds:

Our sled building process went as expected with no issues, we made an extra for the tournament in case it snaps again.

Overall we feel really prepared for the tournament. We are only slightly concerned about the match load placement and when it does and doesn't go over with relation to our placement.

Pre-Tournament Preparation Friday, 1/12/24

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Before our tournament on the 13<sup>th</sup>, we decided to touch up some things:

- Match-loading practice (skills)
- Test out autonomous
- Prepare for judging
- Update journals

The following are our preparatory precautions:

- Charge all batteries
- charge controller
- Pack all parts

Friday 1/20/24

## Construction of the Hang

33

### Plan:

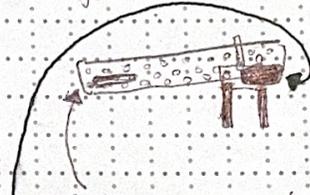
- Construct the ~~robot~~ Hang/Endgame.

### Challenges:

The main struggle we faced while building the hang was maintaining the structural integrity of the hang. When we tested the balancing hang, we ~~often~~ frequently slipped off due to the flimsy nature of the hang.

### Constructing the hang:

We wanted to make a balancing hang, as we believed that it would be simpler than a damping hang. Below is the illustration of the hang.



This component of our hang would hook off to the ~~robot~~ elevation pole, and balancing on the black tube in the middle of the field would enable us to obtain an A-tier hang.

This component of the balancing hang served to keep the hooking mechanism up, so it didn't cross the size limit and didn't hook on early in the match. To release the hook, we simply activated the motor.

Project

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PROPRIETARY INFORMATION

Tuesday 2/13/2024

Plan:

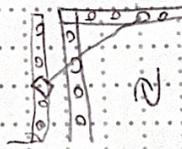
- Wings re-angling
  - ~~wings~~ vertical wings
2. ~~make~~ vertical wings.

Challenges:

We realized that making the vertical c-channel that the stable end of our piston attaches too will be really difficult so we need to build it first.

Designing new wings:

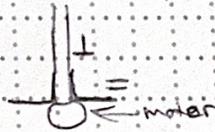
As mentioned before our plan is to make vertical wings because our previous horizontal wings were too pliable and they were extremely unpredictable. Often they would go ~~in~~ down or up instead of a perfect 90° angle and so after a lot of testing and trial and error, we realized that the better solution would be to make vertical wings because under pressure they don't move unpredictably. We planned on doing this by almost rotating our other wings.



Fully extended.

Mounting the vertical c-channel:

We decided to make 2 small 1x2 slits so that we could attach them ~~perpendicular~~ parallel to the surface and also be able to connect the mounting c-channel perpendicular to the surface.



Connecting the piston:

The process was ~~not~~ extremely easy as we just needed to create the 1x2 c-channel slit so we could attach

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## - Connecting Piston



However while the mounting is the same we needed to make the screws loose so that the actual channel that extended had a non-constraining motion. This process was somewhat tedious as we needed to screw in the last mounting before the first and we realized this too late.

Project

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Monday, 2/19/24

### Post-Tournament Fixes

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#### Plan:

- Decrease height of puncher
- Fix wings
- Practice

Decrease height of the puncher:  
To decrease the height of the puncher, we decided to shift the puncher's design from being vertical to being horizontal.

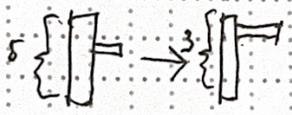
#### Challenges:

##### • Height

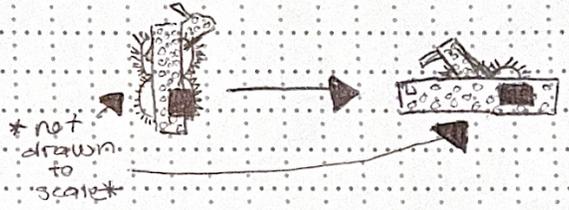
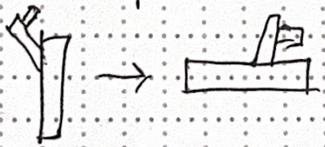
- The height of the whole robot needs to be below 11.5 inches. Puncher is the only thing that needs to be decreased.

##### Solution:

- Cut unused metal on arm

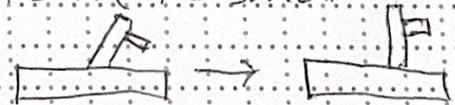


- Turn puncher sideways



To orient the puncher horizontally, we

The puncher already was working well when turned sideways. The main challenge was getting the puncher's height low. First, the arm of the puncher was unnecessarily tall, so we cut it by 3 holes, saving 1.5 inches. This wasn't enough, so we changed the angle of the arm to keep the arc the same.



This is done by changing the hand stop.

With this, the whole robot is able to go under the barrier, and the puncher works the same.

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## Fix wings:

The wings seemed to have been going a little too low down and this was an issue because tribol were slightly wider sometimes. The fix to this was a series of front end error for the placement of the permanently set side at separation on the moving channel.

Also we needed to reduce the size of the wings so that the robot could go under the bar.

