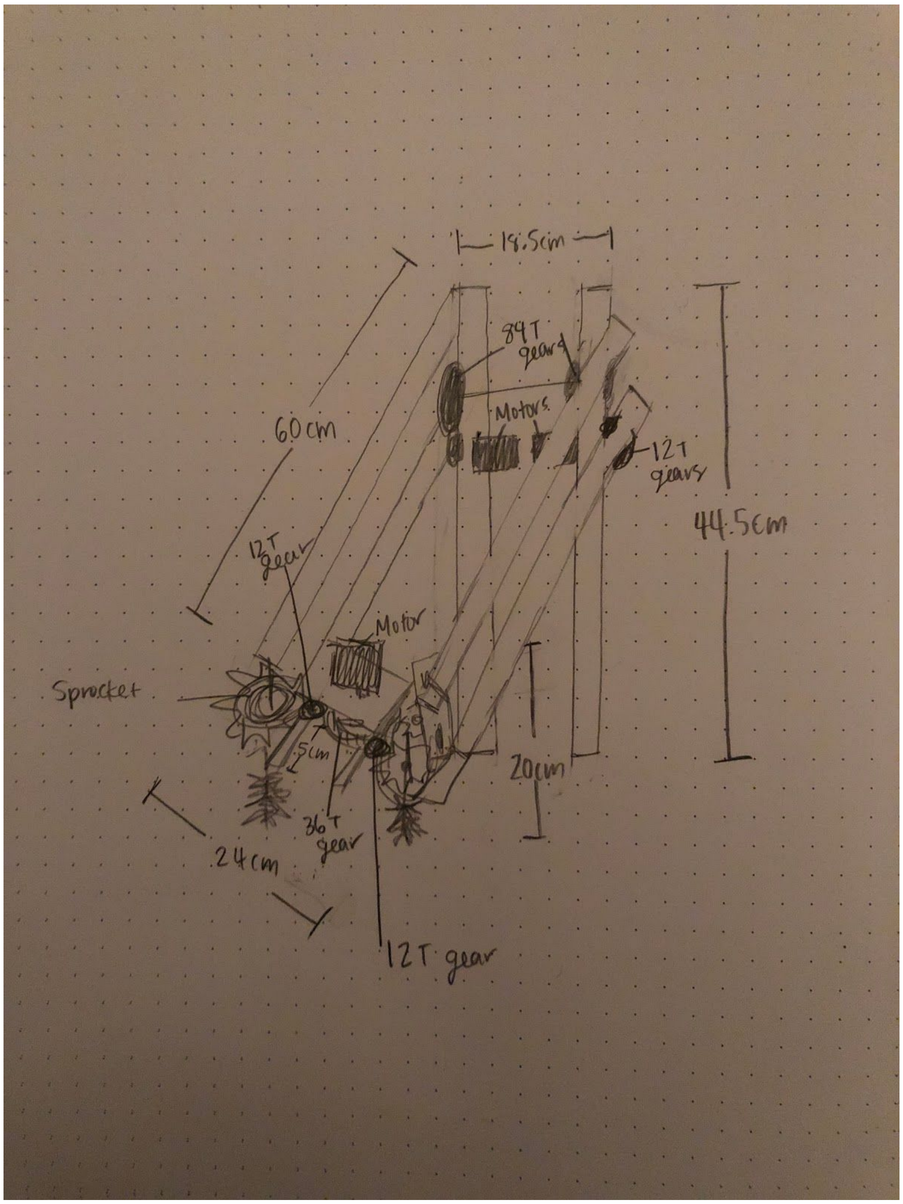
3 Pre-lab

Four-Bar

1. Draw your mechanism. It does not have to be done in CAD (though some of you are so proficient in CAD, you might do so anyway), but it needs to be detailed – and neat! – enough that any one of your classmates could look at it and understand how it works.



2. Describe how the mechanism will be powered: Location of motor(s), transmission (type, gearing, etc.).

The four bar will be powered by the motor moving the bottom 12T gear on the piler, which moves the other top 84T gears. The four bars on both sides are parallel to each other and are both connected to the claw. The claw is powered by a botor moving the center 36T gear. This gear moves two other 12T gears (one on each side) which is connected to two sprockets on the same axle. The claw picks up the pizza to be delivered.

3. Describe how you will control the mechanism during your testing, as well as how you might control it when attached to the BaseBot.

Each motor will be connected to the vex brain, and the structure will be stabilized by someone holding it up (as it is not yet attached to a sturdy base). When the four bar is attached to our BaseBot we can manipulate the motors using the controller. That way, we can move the four bar up and down to test the arm and claw and check whether they are viable options for the challenge/BaseBot.

4. Describe any analysis you have done.

The first iteration of the four bar had supports on the sides which restricted its vertical movement and its ability to use its claw to its fullest extent. The four bar was also built very small, so a longer arm needed to be created, as the robot's reach was limited. We also needed an intake mechanism to grab the pizzas before they are lifted, which lead to the creation of a gear train for our claw. The gearing was also kept in mind, as connecting a smaller gear to the motor would make for a more efficient and fast arm movement.

5. Describe any analysis that you expect to do later.

Through testing we'll test which parts of the mechanism need to be stabilized with the addition of support. We'll also be able to adjust the height of the claw's intake mechanism. We may also need to adjust the gearing to maximize the speed of the arm's movement. Additionally we may need to adjust the claw/four bar to properly attach to the chaise (and vice versa) as well as the ideal size to pick up the pizzas.

6. Describe what you want to learn through testing. For example, accuracy, repeatability, speed.

I'd want to learn how fast the four bars move and how fast the claw opens and closes around the pizza. In addition I'd want to find out how many tries it takes the robot to pick up the pizza and how many times it fails. If the data is precise, then we may need to change the code for the robot or the location of the mechanism, or the way it's going about picking up the pizzas. If our data is not accurate, then we may need to change the way the mechanism works altogether by recreating it to do what we want, or giving it a different functionality.

7. List out the metrics – the data you will collect – to assess performance.

- Time taken to fully raise the four bar
- Time taken to move the claw
- Time taken to grasp the pizza
- How stable is the robot after four bar is lifted to maximum height
- Efficiency in delivering pizzas, measured in time from first contact with a pizza to placement.
- Frequency of human intervention necessary
- Frequency of pizzas dropped

8. Describe what factors you think will affect those outcomes. For example, gearing is an obvious factor for many mechanisms. You do not have to test every single factor (see below), so make this list comprehensive.

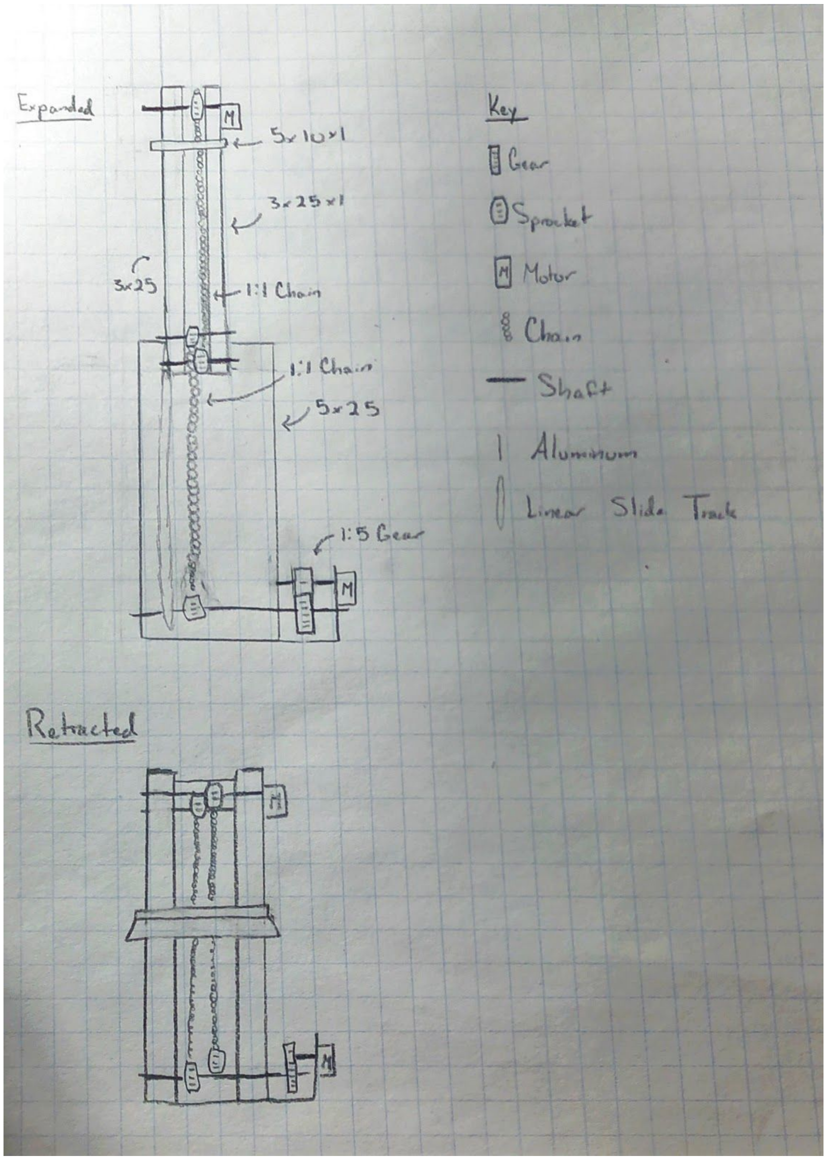
- Gear ratio for each motor/four bar
- Number of motors
- Symmetry of mechanism/base
- Even weight distribution within the robot after mounting mechanism
- Size ratio for each sprocket and chain link
- Speed of each motor
- Voltage supply
- Temperature
- Weather (Wind, water conditions)

9. Describe how you will test those factors – what will you change on the mechanism and how? How many iterations will you perform (hint: N = 1 is grossly inadequate). How many different values of the factor will you test ("low," "medium," and "high" is a good place to start). You must test at least two factors for each mechanism.

To test the gearing we can test the different sized gears and pick the best combination of gears with respect to the motor. Three iterations would be a good starting point. One iteration would be to connect the motor to a small gear which is connected to a large gear. The second iteration would be using two gears of the same size, and the last iteration would be connecting the motor to a large gear which would be connected to a small gear. This would be testing the optimal, most efficient/fast gearing for lifting the arm. To keep things consistent, we can perform the same test for the sprocket and chain. The first iteration would be to connect the motor to a small sprocket which is connected to a large sprocket via a chain. The second iteration would be using two sprocket of the same size, and the last iteration would be connecting the motor to a large sprocket which would be connected to a small sprocket using a chain. Adjustments to torque and speed can be made accordingly. We can change the voltages of the motors through our code to test how the speed of each motor can affect the metrics. We could start at 10% speed and increment by 10% each iteration, ultimately culminating in 9 iterations in order to reach 100%.

Cascade Lift

1.



2. The cascade lift will be powered by two motors. One is located at the base of the mechanism in a 1:3 gear ratio (12 teeth to 36 teeth), which then powers the lower sprocket and chain link. This motor serves to raise and lower the upper section of the lift. The other is mounted directly

with no gear reduction. It is located at the top of the upper sprocket and chain link, and serves to raise and lower the 5x10x1 tray.

3. During our testing, we will control the cascade lift by wiring each motor to the VEX brain and running the motors directly from the brain. When our mechanism is attached to the BaseBot, we will be able to program it so that it can perform autonomous functions and we can control it using the handheld controller.

4. I conducted analysis while prototyping the cascade lift. Initially the lift did not have an upper and lower section, but only the lower 5x25 section. However this was not tall enough to deliver pizzas on the top floors of the dormitories. Furthermore, I made an educated assumption that we would need more speed for raising and lowering the section, and therefore I chose a gear reduction in the lower motor.

5. I expect to analyze a great deal in the future, most of which is performance based. Primarily, this is analyzing whether the lift works as expected to deliver pizza. For example, I will continue to analyze whether or not the height of the tallest dorm is reachable, as well as whether the tray can obtain, lift and place a pizza. I will also analyze whether the lift is within the rules and size limits of the pizza challenge

6. Through testing, I want to learn the repeatability of delivering a pizza, as in whether or not the lift can repeat the process of collecting, lifting and delivering a pizza without damaging itself and lowering its performance. I also want to test the maximum possible speed for raising and lowering the tray to its maximum and minimum height.

7.The data I will likely collect is as follows:

- Time taken to fully raise the lift
- Time taken to fully lower the lift
- How repeated manipulation of the lift affects its stability
- Efficiency in delivering pizzas, measured in time from first contact with a pizza to placement.
- Frequency of human intervention necessary
- Frequency of pizzas dropped

8. Some factors that I think will affect the data collected are:

- Gear ratio for each motor
- Size ratio for each sprocket and chain link
- Speed of each motor
- Location/Mounting of the lift on the BaseBot
- Voltage supply
- Temperature
- Weather (Wind, water conditions)

9. To test how the gear ratio affects the metrics, we can test multiple gear ratios by changing the gears which the motors are connected to. For this, three iterations is a good start, as we can measure a gear reduction (1:>1), a 1:1 ratio, and overdrive (>1:1). Based upon which of these is best, we could then perform more iterations to find the ideal ratio.
Similarly we can alter the ratio for both sprocket and chain links, also with three iterations, to determine whether or not we need more torque or more speed.
To test how the speed of each motor can affect the metrics, we can program the motors to run at various percentages. I think that five iterations would be sufficient for this testing, beginning at 20% speed and increasing by 20% until 100% speed is reached.