Practice 1-9/7/19-Launch Video

We watched the launch video and set basic objectives for the robot.

Autonomous

1-use Vuforia to scan for skystone

2-use autonomous methods to navigate to skystone

3-collect skystone using grabber

4-navigate through team bridge to the foundation with skystone

5-place skystone on foundation

6-move foundation to the building area

TeleOp

Run 3-5 loops of the following:

1. Collect stone
2. Drive through team bridge
3. Place stone on top of previous stone on foundation

End Game

1. Place capstone on sky scraper
2. Move foundation away from build site
3. Park in the building site

Practice 2-9/14/19-Travel Paths and Scoring

We calculated likely travel routs for the robot based on the objectives. The team correct a previous misconception about the travel route, which was that the team did not need make a long traverse of the board until the first 6 stones had been placed. This meant that the total distance traveled was not as great as the team thought.

The team considered the fastest rout, the highest scoring route and the easiest route. There was considerable discussion about the routes, however, because of concerns regarding the behavior of the others and potential traffic jams.

The team ultimately decided that a loop might make the most sense where the team bridge operates only in the direction toward the foundation and the larger bridge operates I the opposite direction. This would limit head-on collisions or stalled vehicles creating problems for the team

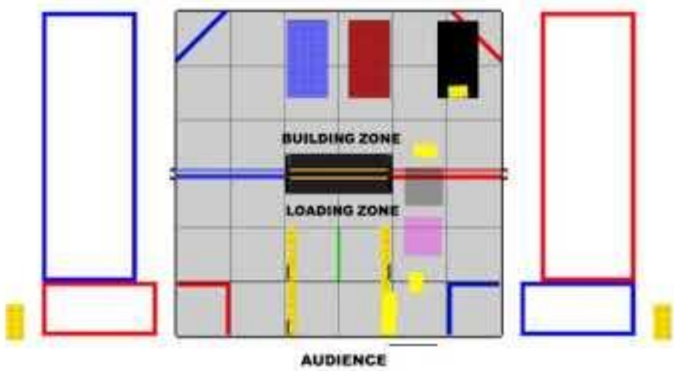
The team also discussed whether one member of the group would deliver stones to the bridge and the other member would stack the stones. This would increase the efficiency of the system because it would dramatically reduce the total driving distance since no one would have to drive through the larger bridge.

The team calculated the speed that the robot would need to travel to make a tower of 6 blocks. In order to do this, the team made some assumptions about the time needed to collect a stone and the time needed to place the stone. The team then measured the distance using the CAD measuring tools inside of Inventor Pro and the CAD models distributed by AndyMark.

This is a video of some possibilities with animation using PowerPoint-You will need to use a lot of pausing to make everything make sense.

[redacted]

Figure 1.3-1 – Isometric view of the *Playing Field*



[redacted]

Practice 3-9/21/19-Stone Towers

The team explored two major and related areas: the 12” linear slide dimensions and the stability of the tower.

Since the team was planning to drive under the team bridge, they needed to make the robot under 14” high. This meant that the 16” and 20” drawer sliders would be too long. The team considered cutting the sliders to a smaller distance but since the sliders are steel, not aluminum, the team was nervous about cutting the sliders to size. The team decided to start with the 12” sliders.

The team spent considerable time exploring how the sliders could be assembled and taken apart until they got confident with the process. The team learned to remove the back stops by bending them with vice grips. The team also learned that placing the ball bearings was challenging and that they needed to be thoughtful about this process.

The team extended a single three stage slider to determine that the total height was about double the initial height, 24 inches. Would enable the lifter to reach a height of25 inches total, assuming that the lifter is mounted about 1” off of the ground. The maximum height of a stone with such a lifter would be considerably less, however, because the stones would start on the foundation. This means that the stone would likely get no higher than 6 “ less than the top, for a total of 19” with a single stage.

This meant that the team needed to learn to assemble two stages together. This was done by mounting the base of once stage to the top of another stage. This was accomplished by taking the assembly apart and connecting the base to the top stage using the M3 screws from the Tetrix Kit.

The team managed to assemble the sliders but there was some interference from the screws because the sliders did not have enough clearance. The team discussed cutting the screw to create more room or finding shorted screws. Nevertheless, the two sliders linked together has a total lift height of 36”, which was considerably more than the team needed based on their immediate goals.

The next steps for the lifter would be:

1) Find shorter screws to solve clearance problems
2) Find adequate pulleys for the lifter
3) Mount the pulleys to the lifter
4) Find an adequate rope/cable for the lifter-determine the necessary length (metal is less likely to snag, break but it is more stiff
5) Make sufficient anchors for the pulley system
6) Find a spool for the pulley system (larger will prevent snags but it will take up more space)
7) Mount the system to a tetrix channel
8) Mount a motor to the system and connect the motor to the spool
9) Determine the speed, power, torque of the lifter-determine if gears are needed
10) Mount the system to a robot chassis to determine the impact on the dimensions of the robot to make sure that it can still go under bridge and fit inside sizing box.
11) Design a grabber, using servos, (maybe stepper motor like 3D printer) to hold the stones inside the lifter for placement onto the foundation.
12) Mount the grabber to the lifter and test that it is the correct size
13) Test the grabber and lifter for lifting a strong and placing it onto the foundation.

The team met today and explored the stability of the tower with 6 stones. Such as tower was 24” tall with a total height of 26” above the ground (2” because of foundation).

The team explore the theory of stability, meaning that the center of gravity of the tower could not cross the pivot point without the tower falling.

Assuming that the tower is roughly 24” by 8”, and that it is roughly uniform, meant that the center of gravity would be at 12” high and 4” across the tower. The team did not know how to use Inventor Pro to solve this problem, but the team had an angle measuring device which allowed them to take measurements of the angle that tower had to be moved in order to fall. The data indicated an angle around 23 degrees.

When the tower was position in the other orientation, the team determined that the angle was significantly less.

Together, these findings mean that the robot should place the stones on the foundation in such an orientation that the stones are aligned so long side of the stone is parallel with the short side of the foundation. This gives the most stability when the foundation is moved during the end game.

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Geometric Analysis

Using Inventor pro, a 2D shape was created with the dimensions of 8” by 24”. The center of this rectangle was marked. Then, the rectangle was rotated on lower left vertex until the center point crossed over a line perpendicular to the lower left vertex, the pivot point. When rotating on the longer side, the shape needed to be rotated 20 degrees. When rotating on the shorter side, the shape needed to be rotated only 10 degrees. This confirms the angle measurements from the team during practice.

Next Practice—

At this point, the team understands the performance needed from the robot in terms of speed and how to orient the blocks to maximize stability. The next step will be to conduct an analysis of the lighting requirements for the camera to detect the skystones using the webcam. The team will specifically test the relationship between the height and angle of the camera relative to the distance to the skystone. The team goal of this process will be to make a fixed mount to control the height and angle to optimize the detection of the skystones.

3a- set-up notes

Charged both phones

Taped SIM cards to cases

Logged-in as pkeenanfitzgerald@gmail.com

Logged into Vuforia to verify key is current…

pkfitz@tipsvt.org (Tipsvt9721)

downloaded and important robot controller app 5.0

ran app and could not find skystone updates

downloaded and imported robot control app 5.2

ran app and found skystone

modified phone set-up to turn on developer mode and usb debugging

phone did not appear in android studio

went to sdk manager and added googld usb drivers

https://developer.android.com/studio/run/win-usb

https://developer.android.com/studio/run/oem-usb.html#InstallingDriver

//this did not help the phone to be detected

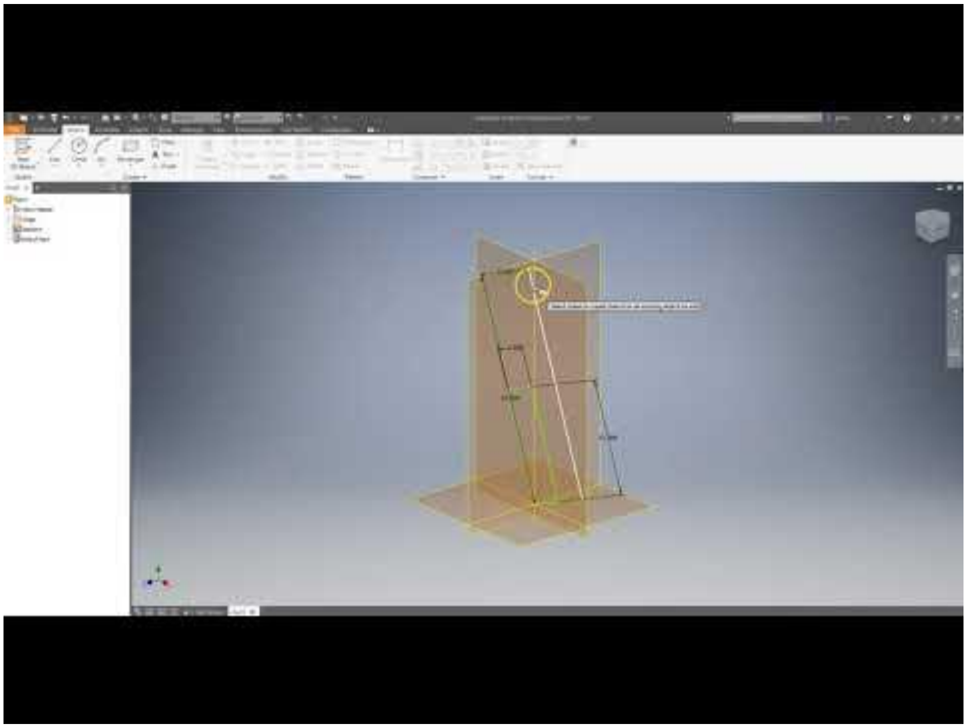
https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/android-studio-tutorial.pdf

This link was used to set-up the phones, regardless of Android Studio

Problem was solved when I realized that the control hub was not the same thing as wifi direct. We don't have a wirelss control hub, so everything worked when I went to wifi direct.

Practice 4-9/27/19-Sliders

Kenny watched the CAD geometry video on the tipping point of the towers.



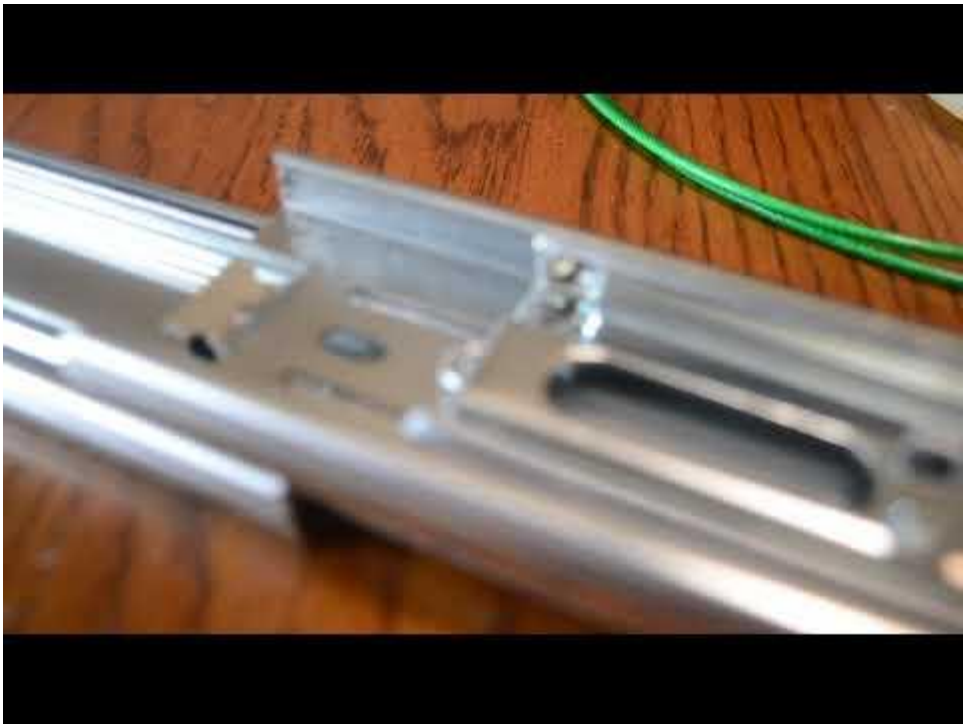
Then, Kenny began working on the clearance issues for the linear slides. He first replaced a screw that appeared to be hitting on the second stage.

He first used a tetrix nut, but it appeared to have a different thread pattern despite being an M4 fastener. He then used 1 of the new nts, but it was too small to hold in place with bare fingers. He used a vice grip to hold it in place to fasten the shorted M4 screw. The clearance was much better.

During testing, Kenny discovered that the clearance issue persisted because he could near the metal on metal contact. The clearance issue was with a second fastener, which was hidden from sight by the second stage. Kenny replaced this fastener and then re-assembled the whole apparatus. When he tested it, it worked without any audible contacts.

Slider Videos

Slider V1



Slider V2

Slider V3

Andrew worked on an analysis of the tower. He first positioned the tower on one end of the foundation. He stacked (15?) blocks on it before it failed. It leaned to one direction. We asked the questions, why that direction and not the other?

Kenny thought it might be because they were leaning toward the side they were on? Another suggestion was that the floor might not be level. The floor was checked and it was not level.

The tower was also placed on the opposite side of the foundation with similar results but the lean was the exact opposite. This leant credence to the idea that the tower would lean away from the center of the foundation.

To test this, the tower was then built in the center of the foundation. This resulted in a higher tower, by almost 5 stones.

The team set-out to test if additional stones could be placed to brace the bottom of the tower. When this was done, the first brace was placed on the outside of the tower, relative to the foundation. This caused the tower to fail sooner because the angle of the top was more sharp.

The braces were then placed on the inside of the tower, which resulted in a taller tower than with no brace. This led the team to consider the possibility that the foundation was slanting and that the addition strones were acting like counter balances.

The team tested this theory and determined that it was accurate.

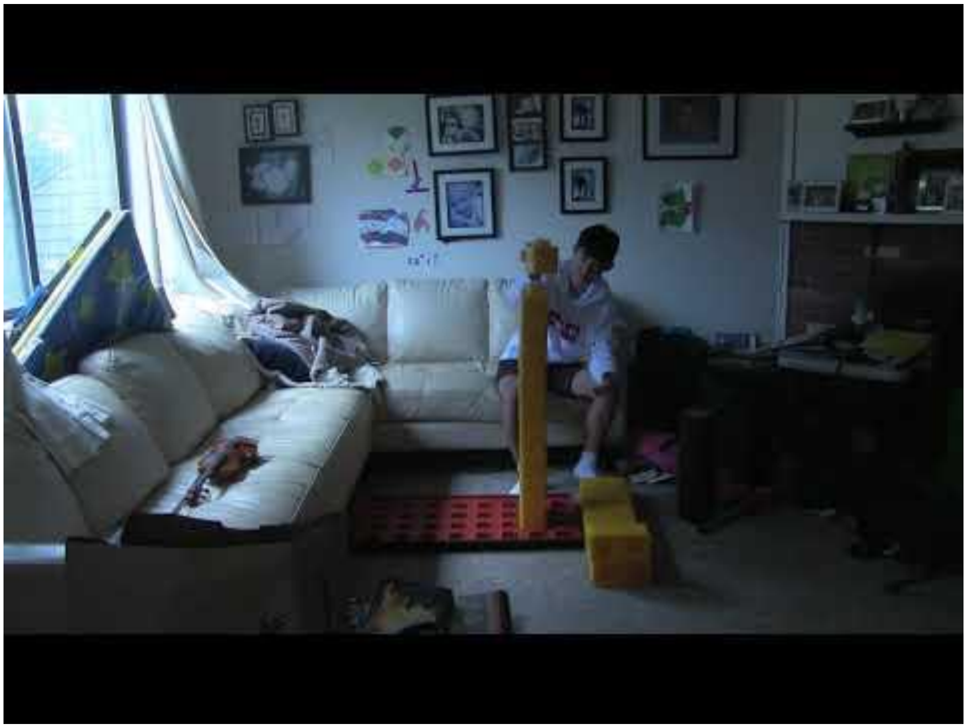
Luke-speed analysis

Kenny-geometric stability

Andrew-tower stability

Tower Videos

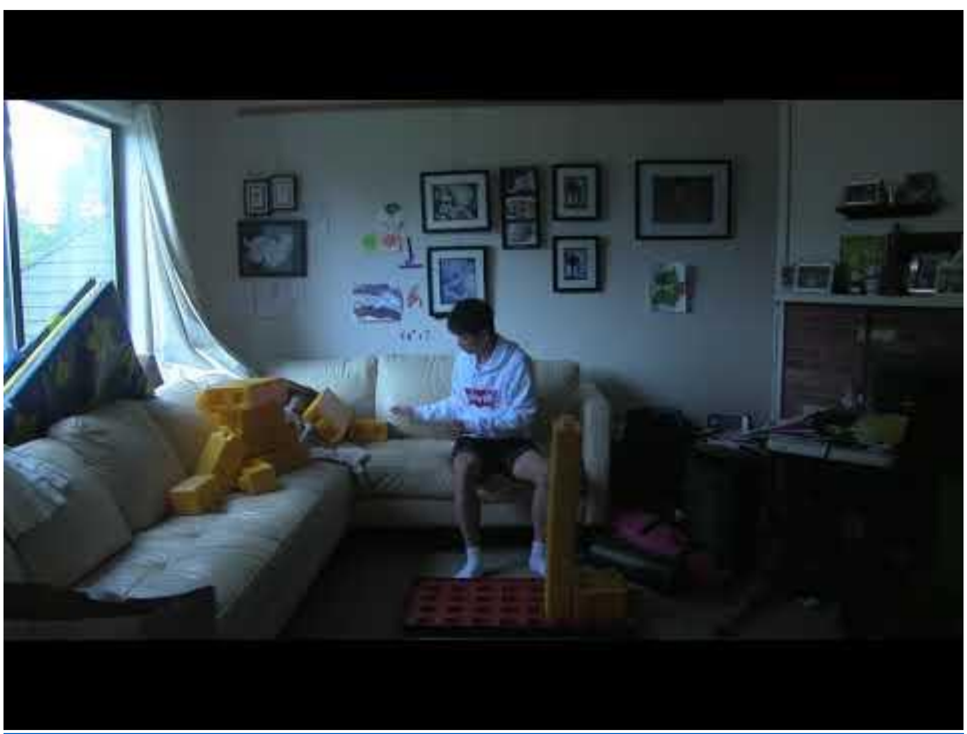
V1-stack near center left



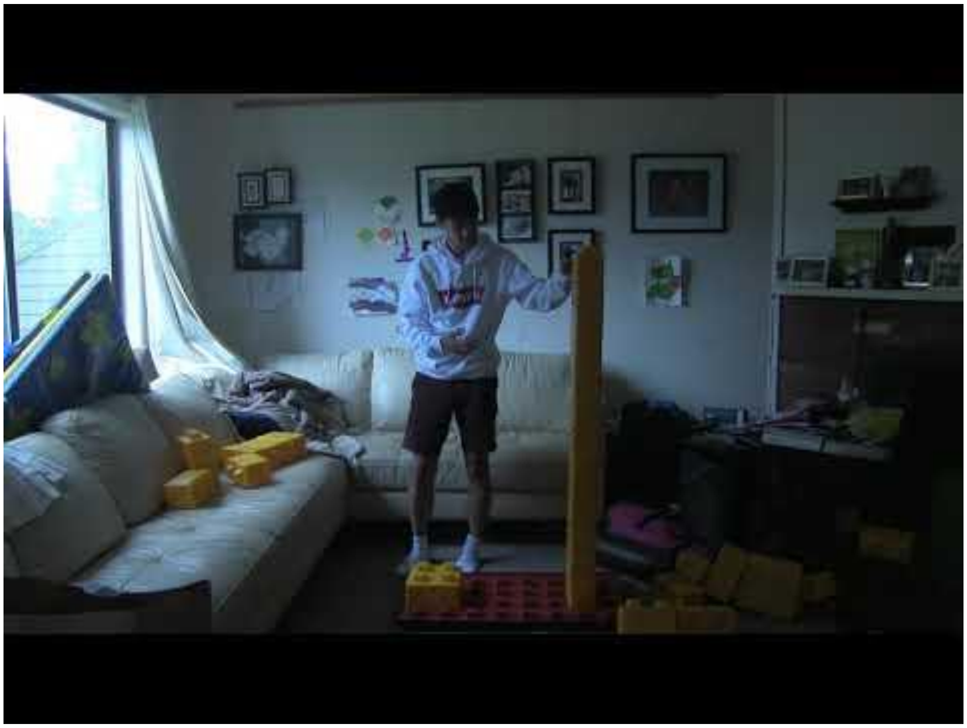
v2-stack far Left

v3-stack with Brace

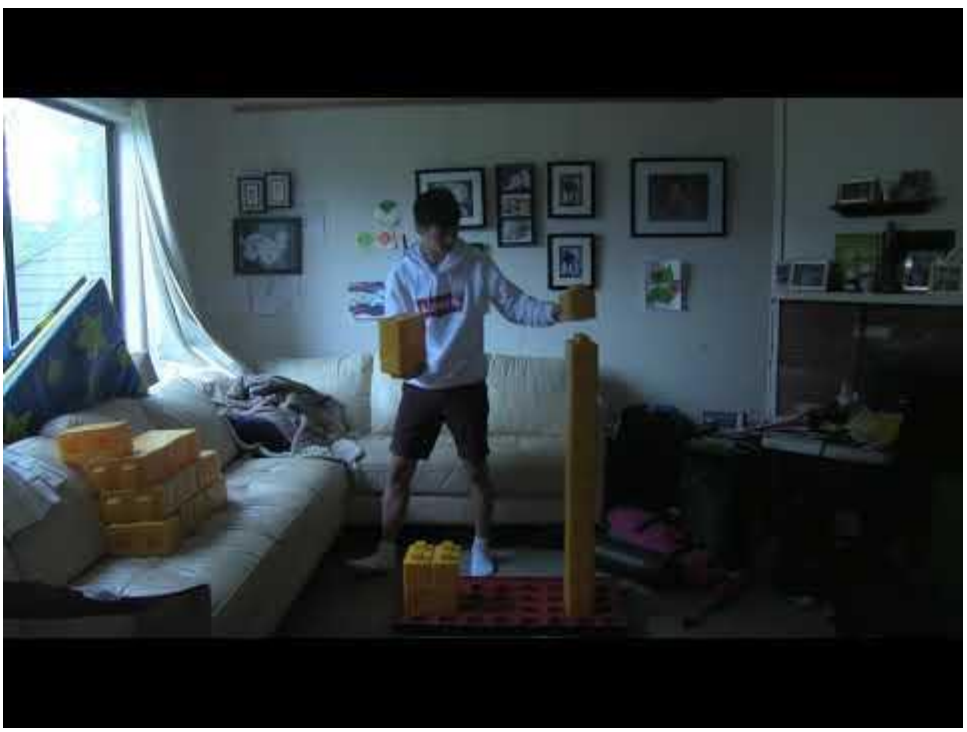
v4-stack with counter balance



v5-stand with double counter balance



v6-stack with large double counterbalance



4a

Testing of moto4 built-in camera and image targets

The image targets for object detection are very difficult to detect. The lighting seems critical. Likewise, adding the images to the stones is not obvious. I wonder if smaller differences will present a problem.

The output is information on two corners of the image. These will require some further testing to learn more about how that information can be used to determine how to navigate to the particular stone and to interact with other robots that might have the same intentions. Perhaps a pattern to move to the nearest stone, while tracking it in case it moves while the approach is being taken.

This suggests that the navigation with the tensor flow may be critical.

After some initial work with tensor flow, I determined that the object dectection appears to dected regular stones and not the stones with the image target. This suggests that the image target may be in another section like VeMark detection and so on. IN order to check, I opened those demo files as well.

IN order to use wifi debugging, I had to re-use ADB shell commands as the following on my pc

C:\\Users\pkeen\AppData\Local\Android\Sdk\platform-tools\adb devices

C:\\Users\pkeen\AppData\Local\Android\Sdk\platform-tools\adb tcpip 5555

C:\\Users\pkeen\AppData\Local\Android\Sdk\platform-tools\adb connect 192.168.92.250

It is also important to note that the computer and the phones need to be on the same wifi. I am not sure that the signal persists when the phone is re-loaded because I think the app controls the wifi Direct network, but maybe not.

I tested the vumark files and they did not detect the skystone with the image. This suggests that FIRST wants kids to train a tensor flow data set and integrate it into the program. This may be the next step. In might run in parallel with a program that uses the color detector to run along side the skystones to find one with the sticker.

//

Finally got the system to work. The phone camera needs to be about 22” away from the stone. It needs to be about 10” off of the ground. The camera needs to at an angle of around 105 degrees or 75 degrees, depending upon a point of reference. In this situation, the camera can detect the difference between a skystone and a stone.

The next step for testing will be to determine how much of an improvement is gained form using the webcam and whether the cam could detect from a greater range of possible values.

Autonomous Design Updates

1. The robots need to start on the wall in front of the team. This make navigation tricky because it is not clear where the other robot will be.
2. The robots get points for parking on the line. This appears easy. However, the robot might need to consider parking on the inside or outside to make room for both robots. If a robot parks in the middle, both robots will not fit.
3. the team is not allowed to touch the other team's foundation. This means that a robot would need to be narrow enough to get the foundation "in" the build site and potentially drive away.
4. The team will most likely want to make multiple routines for a variety of scenarios, such as:
    a. Parter team can do either the foundation or the skystone but not both
    b. Partner team does not do autonomous
    c. Partner team does all of autonomous and just wants us to park (or get a skystone and then park)
5. The teleOp will likely need to be multiple scenarios, such as:
    a. Partner is inoperable
    b. Partner cannot lift but it can push stones
    c. Partner can operate fully and better than our team
6. The end game will likely have multiple scenarios, such as:
    a. Partner team is better at foundation, so we defer
    b. Partner team does not do foundation
    c. Partner team cap does not stack
    d. Partner team cap does stack
7. This is another entry

For next practice…

Building Cascading Linear Slide from Cabinet Sliders

I spent a lot of time making drawings of sliders and evaluating how to string the anchor and pulley cables to make each section move.

After some initial struggles, I attempted to rig the wires inside the connectors. I was using monofilament (40 lbs bright green). I initially tried to rig things with all of the stages intact, but I found it difficult to see the potential locations for anchors and pulleys.

In time, I pulled the structure apart and assembled it one stage at a time. This made it easier to identify some locations for anchor points and pulley placement.

One of the hardest things was that the first stage and subsequent stages are different. On the first stage, only two sections are connected. The third stage is then connected to the first stage, through the second stage, such that when the second stage is lifted by the first, the third is lifted by the second. This pattern is repeated for the fourth, fifth and sixth stages.

The monofilament fit easily into spaces between sections but it was challenging to fit it correctly because the knots I tied came loose over time, which made the connections challenging. Also, there was no obvious way to integrate pulley wheels into this particular design, which made it harder to use because of the friction on the monofilament across sections.

Another issue is section the anchor point relative to the stage. As the entire structure expanded, the lengths of the lines were often not able to enable the full extension of the structure.

It would make sense to map out these positions more clearly, try some different materials for the rigging and measure the forces required.

Alternatively, these challenges encouraged me to consider the possibility of using only the first few stages, which are larger and uniform on their outside lines. This means that an external system might work using fasteners such as rivots, glue or welding.

I drilled through the sides of the base stage for three different base stages. I used a M3 hard metal drill bit. I attempted to drill through the slot for the ball bearings, which was tricky because the lighting in the garage was poor. That being said, the drill press made quick work of the task.

Once the holes were made, I used the rev hardware to fasten things together. The biggest thing was the rev pulley bearings. This seemed to work well and appeared to make significant improvement over using the internal sliding mecanisms for several reasons.

First, the rev pulley made the lift feel like it was easier to operate base on pulling on the string to get it moving. Second, the rec pulleys organized the rigging so that it was much more clear. Thirdly, by using the base stages, the enter lift could be controlled with only two rigging wires.

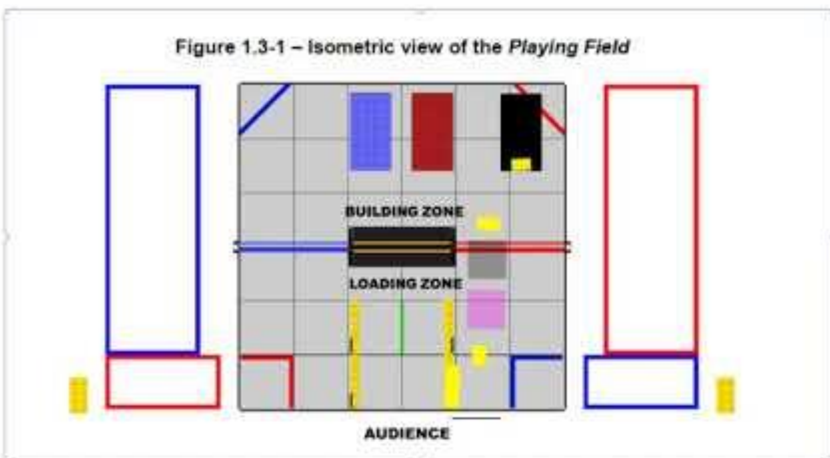
Later today, I wanted to make the field of view for the phone camera and compare it to the webcam. I also want to collect some data on the detection time of the camera.

I also want to take some time to explore programming a 2d simulation of the game on Unity in order to anticipate how other teams might choose to cooperate on using the simulation.

Practice 5-10/4/19-Game Animations and Game Theory

The team reviewed some game animations and considered different ways that the robots might interact with one another. This encouraged the team to spend more time anticipating how the other teams might plan for their autonomous.

[redacted]



[redacted]

The team explored the cabinet slider linear lift. The initial program worked logically but did not provide sufficient power to lift the entire apparatus. The initial power setting was .1 and it happened to work in the correct directions.

The power was boosted to .2, which was sufficient to lift he entire apparatus. It appears slow so the team discussed increasing the power to the motor.

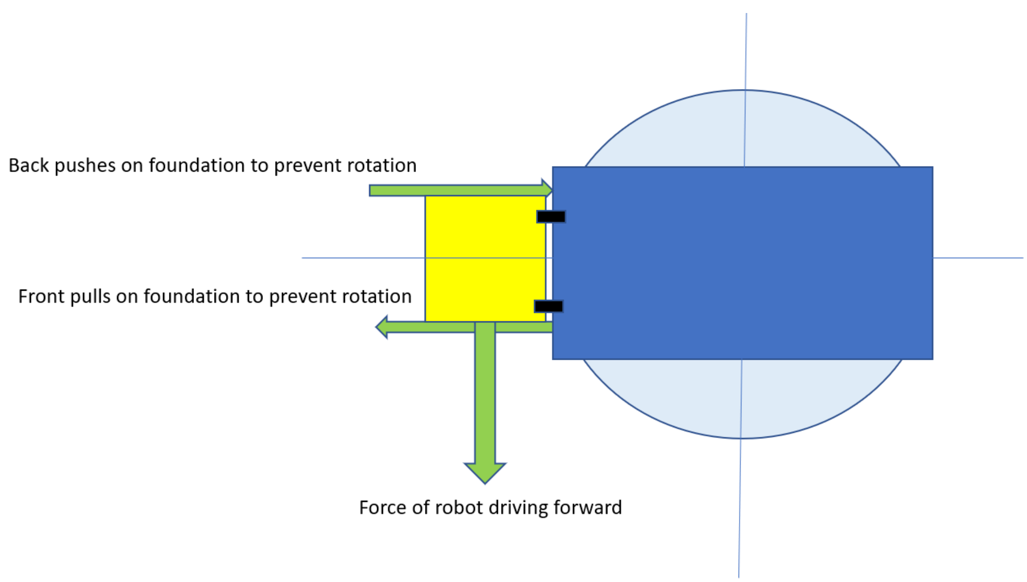
The team then conducted several trials to determine if the amount of force that was needed was constant or if it varied. The team explored this possibility because Luke observed that it seemed to take more force to lift the object as it got higher. If this was the case, the team would need to modify the program that operated the lift to increase or decrease the power on the lift based on the height of the lift. Luke struggled a little to adjust the tare settings on the force meter to operate the force meter. This may have had a role in the data that suggested that the force was different at different heights.

The team also collected data on the impact of the angle of the pulley rope on the total amount of force needed. The team considered this because they through that the angle might make if easier or hard to operate the device.

When the team deliberately collected data on the lifter and discovered no clear pattern in the operation of the lift as it relates to the lifting. There were changes, but they were not consistent. It seemed like the small differences might have more to do with the consistency of the pulling and less with the actual forces involved in operating the device. This is likely due to the fact that the apparatus has to hold the whole weight of the apparatus the whole time so the height does not change what is needed to hold object. This means that the team should program the power to hold the maximum force and they do not need to adjust it for height. This makes for a much simpler program.

The team also discovered that the angle did not appear to make any difference in the force needed to operate the lifter. This suggested that the angle did not matter. This may be due to the fact that the force is operated over the pulley so the angle of the pull, after the pulley, does not matter. This means that the motor can be placed in any position the team desires because the angle did not matter.

The team conducted some preliminary testing on the foundation on the tiles. Pulling from the center, it took a little more than 3.3 lbs of force to drag the foundation. Pulling form the sides just caused the foundation to rotate, which was expected.



It is unclear if the robot can exert these types of forces on the foundation so the team might want to focus on using multiple points of contact and dragging the foundation from the center.

The team also spent some time exploring the tensor flow with the on phone camera. Before starting, the team review a couple of basic ideas in optics.

Light waves travel in relatively staight lines that spread over time. This means that objects can be in front of the camera but not in view.

This also means that as the distance between the camera and the subject increases, the camera has less resolution.

They discovered several interesting findings.

First, the on phone camera needs to be at a distance of 17-22 inches to detect a stone.

Second, the phone camera does not seem to consistently pick-up multiple objects, despite those objects bring in view.

Third, the camera appears to have a bias toward the object on the left when multiple objects are in view.

Fourth, the camera appears to “hold” an object when it is detectde and register it as present even when the camera is not likely to be detecting it.

The team discoved that tensor flow can pick-up objects relatively quickly but not multiple objects.

The team set-ou to test whether or not tensor flow could pick-up multiple objects, such as a string of stones. In this case, tensor flow detected a single vut very large stone.

The team tested the idea that tensor flow might need a gap between the objects in order to detect multiple objets. If this was the case, then the robot might have to ram the long line of stones to identify the corect skystone.

The team did not get the camera to consistently identify multiple objects, so this testing was not considered succcessful

Based on the preliminary findings, the team determined that the foundation appeared easier to manage than the sky stone, so this would be the preliminary goal.

The team also determined that he web cam might dramatically out-perform the web camera so it was a goal to conduct testing with the web cam.

Another possiblity might be that the detection of stones might work better with a dark floor for contrast. Our testing was done using a dark brown table and not a gray floor. This may have had an impact on the results.

Next time…

1) Mount and test Hd mecanum wheels for drift with straight and drift with strafe.
2) Test mecaum wheels for maximum drag (see if it is over 3.6 lbs)
3) Mount and test omni wheels for drift with straight and drift with strafe.
4) Test mecaum wheels for maximum drag (see if it is over 3.6 lbs)
5) Foundation gripper design ideas
6) Lifter gripper design ideas

5a.

I ran some additional testing on tensor flow. I discovered the following:

1) The background was too busy on the table-when I placed a dark background behind the strones, the robot could detect the stones easier.
2) The minimum distance between stones appears to be 2”. If the stones are 2” or more apart, they can be seen as individual stones. Otherwise, they appear as a very large stone.
3) the web cam can fit as many as (3) stones on the screen and detect them at a distance of 22”. However, it is unclear that they could be detected at a greater distance. At this distance they fill the screen.
4) the javdoc indicates that the program can return a number of values regarding an object deteciton but they are all relative to the image itself. A series of calculations would be required to use this data to determine the distance to the target. These calculations are worth doing.
5) If the stones need at ;east 2” of seperation, then the large blob that results from the stones being adjacent to one another might make the effort to use tensor flow a waste of time. It might make more sense to drive very close to the stones using the color sensor. That being said, being close to the stones might pose a problem with the other robots if something changes because it is a dead renocking approach that can’t adapt easily to a changing field.

Outline of program

1) Identify a skystone-drive slowly until it is detected-use distance sensor until in range-repeat until detect a skystone
2) Strafe until estimated angle to target is 0?-calculate distance using distance sensor
3) Calculate the distance to verify based on the regression analysis
4) Regression Analysis
    a. Place camera in a fixed position and a fixed angle
    b. Align the camera to have a 0 estimated angle to object (negative angles place object to right, positie angles pace object to left, relative to the camera when facing forward)
    c. Measure the distance (laser range finder or laser 2m distance sensor)
    d. Run the teleOp that produces the height of the object box. Record in excel
    e. Repeat the distance, height measurements for at least 5 positions.
    f. Run a scatter plot and add trend lines until you find the best fit
    g. Take the equation with the best fit and write a new program that will use the trend line to calculate an estimated distance
5) Programming Error
    a. Run the new program to estimate the distance to the object-measure and verify the actual distance. Repeat this three times each at 10 different distances. Make a data table of the estimated distances and the actual distances.
    b. Calculate the percent error at each distance-plot the percent error to determine if there is a pattern in the data-add trend lines to see if there are any significant patterns in the data
    c. If the percent error is acceptable-make a confidence interval for the data that is +/- an acceptable error
6) Write an integrated program, for testing, that places all of the tensor flow navigation data into a method that can be called during an autonomous program. Make the output of the data soemthing that can be an input distance for the autonomous navigation program, such as forward(double distance)

Navigation methods

Dead renocking

Forward(distance, power), backward(distance, power)
StrafeRight(distance,power), StrafeLeft(distance,power)
rotateRight(distance,power), rotateLeft(distance,power)
//bonus
arcRight(radius1, radius2, final heading), arcLeft(radius1, radius2, finalHeading)

Dead renocking with robot detection (ultrasonic and distance sensors integrated into programs)

//sonar style program-give heading, position and size of object detectde by sonar)

//write data to file for statistical analysis

Design Notes for Rookie Robot information

Tools

Fasteners

techniques

Sequencing

1) Horizontal base
2) Moto placement
3) Controller placement
4) Battery placement
5) Hub and Web Cam Placement
6) Adding spines
7) Going vertical for casing

Practice 6-10/11/19-Speed analysis and Gripper

Luke and Andrew met from 9-11.

Luke worked on a revision of the robot speed analysis.

TeleOp-strategy 1 (inoperable partner)

- In this scenario, the robot works alone so it can pass easily through the team bridge without conflict with other robots.
- This scenario also assumes that the opposing team does not interact with our team's stones.

TeleOp Data for Unassisted Scenario						
number of tips	drive distance to stone	time to collect stone	time to deposit stone	total distance	time per trip	speed(feet per second)
5	11	5	5	22	8	2.75
4	11	5	5	22	12.5	1.76
3	11	5	5	22	20	1.1

Andrew worked on building his understanding of the gripper for the foundation. When doing this, the he considered using a REV servo, which was mounted to a REV metal servo mount and then an inside L connector for Tetrix. He then explored using a cam style gear, such as the gear from VEX that we used a few years ago on the shooter.

Andrew developed several concerns regarding this design. The first was that the gear acts like a lever on the servo, meaning that the further the lever extends, the harder it will be to hold it in place. He did not get to a point of testing with this design, however.

Andrew felt that the current tetrix frame was at least a single channel too high for mounting a simple grabber for the foundation. They discussed moving the forward channel lower so that the gear holding the foundation could be smaller because the distance from the channel to the foundation would be smaller.

They also discussed trying to shift the force so it was more aligned with the movement of the foundation.

Both Andrew and Luke worked together on an analysis of the frame designs. The tetrix frame is large, which can make it difficult to make a plastic housing.

Luke constructed a rev frame using the metal L brackets. This frame was not as strong as we had hoped when bent away from the L connector. We considered the possibility that the joint would be stronger if the rev extrusions were cut at a 4 degree angle.

We found a few older pieices already but at 45 degrees and tested this theory. The 45 degree end pieces did indeed form a strong joint.

They both felt pretty good about moving forward with the rev frame, as long as it was cut 45 degrees for the mecanum wheels. The team also discussed using OTS aluminum L's, cut for size, which would be mounted to either tetrix or REV to form the vertical supports for plastic casing. This would eliminate the need for using vertical channels/extrusions unless they were supporting some type of load.

They wanted to keep the idea of a tetrix spine that ran through the rev frame to make it easier to mount heavier devices to operate vertically.

They also discussed which motors to order and compare the new REV motors. REV motors were preferred because the encoders do not need an adaptor to be used with the expansion hub. This reduces 4 connections, which reduces the over-all chances of a failure.

The documentation contained very little information on the encoders, if available. In order to better understand how an encoder might be used, the team downloaded the CAD file to see if there was a location for the encoder wires, as it is the case with the HD motor. There was a place for the encoder so the next step would be to order a few motors to see how they compare to the current motors.

This video helps illustrate the differences.

Based on the current configuration, it appears like the best set-up would be for the more experienced team to use the planetary motors (8) and gift the spur gears (4 REV and 4 Tetrix) to the younger team.

There are several un-resolved issues

1) Grabber for the stones
2) Mount grabber to cabinet sliders
3) Develop cabinet slider control mechanism (single axles with something like laundry line wheels)
4) Place tensor flow camera to identify skystone
5) Color sensor back-up for tensor flow

--

Things are beginning to come into sight for the robot.

--

6a.

Conducted some preliminary work on learning to write data to a text file for analysis. This was considerably more difficult than I would have imagined. The problem began with the basics of copy and pasting of code from the internet.

When I executed the codes, I received no errors and I produced no files.

In the process of learning more about this, I began exploring the phone file system more and discovered text files that had been written by the app. These files were evident on the file manager for the phones.

I explored these in more detail and found that there was a new loggig feature in the app. I explored the JavaDoc and found more references to the methods.

As I explored more copy and paste code, I discovered that I wanted to write data to external memory so that I could read the data in other apps. Apparently, the internal memory does not allow you to read the data with other apps.

As I explored this in more detail, I leaned that the manifest file needed to have permissions set to allow for the data to be written.

I tested to see if this was the problem and it was not.

Eventually, I found that these methods would work as long as I:

imported these classes:

```
import android.os.Environment;
import java.io.DataInputStream;
import java.io.DataOutputStream;
import java.io.File;
import java.io.FileNotFoundException;
import java.io.FileOutputStream;
import java.io.FileInputStream;
import java.io.IOException;
import java.io.FileOutputStream;
```

declared these variables:

```
public final static String filename = "Data.txt";
public String data;
```

and passed a string to these methods:

```
//These methods were added from the TestFolderAccess.java file
public void writeData(String data){
    File sdCard = Environment.getExternalStorageDirectory();
    File f = new File(sdCard, filename);

    try {
        FileOutputStream fos = new FileOutputStream(f);

        fos.write(data.getBytes());

    } catch (FileNotFoundException e) {
        e.printStackTrace();
    } catch (IOException e) {
        e.printStackTrace();
    }
}
public void appendData(String data) {
    File sdCard = Environment.getExternalStorageDirectory();
    File f = new File(sdCard, filename);

    try {
        //This is the only difference beteen created and appeending the data-set the
parameter
        //to true and it will automatically append the data.

        FileOutputStream fos = new FileOutputStream(f, true);


        fos.write(data.getBytes());

    } catch (FileNotFoundException e) {
        e.printStackTrace();
    } catch (IOException e) {
        e.printStackTrace();
    }
}
```

Then, inside a loop in the OpMode, something like this could be placed”

```
if(recognition.getLabel()=="Skystone"){
    data=""+recognition.getHeight() +"\n";
    appendData(data);
}
```

In order to conduct more accurate testing of this idea, I mounted the webcam to the robot frame. The webcam takes a ¼” 20 screw. I looked high and low for screws that would work best and decided to mount a nut to a 1/2 “ length screw. This made the screw about ¼”, which worked fine. Getting the screw in and out of the mount was tricky because none of the tools fit easily through the channel.

Nevertheless, the mount worked for the webcam and it successfully entered data to a text file.

The next step would be to add a distance sensor

Also took a look at dragging the foundation using a medium motor and a hook. It took a while to mount the motor to the channel but that was solved.

Then, a hook was assembled from several pieces of flats. The hook could not hold its position.

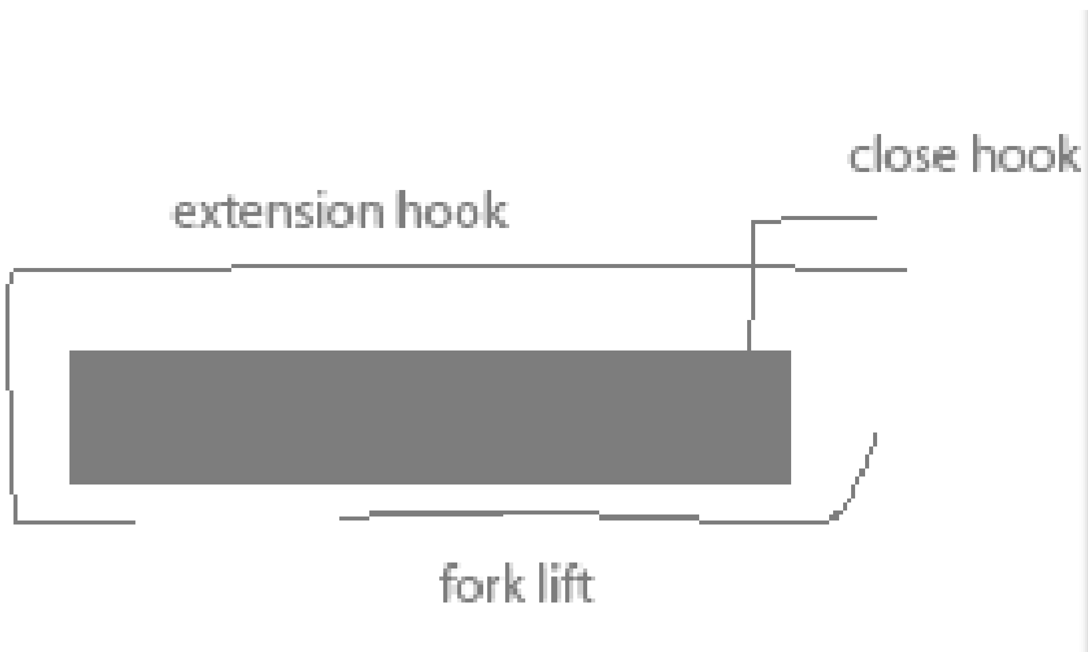
A second hook was designed and tested but this too could not hold the position because when the robot moved backward, the hook slid over the top of the foundation.

Another potential design would be to hold the hook in place using a sprocket and prawl.

Another potential design would be to place the hook on the opposite side of the foundation. This was attempted but the hook failed, again.

A tooth was added to the hook and it held the foundation in place. The main problem with this approach is that the hook needed to be extended nearly 23" to cross the foundation. This distance would require a cabinet slider to cross. It is unclear that such as slider could withstand the forces from dragging the foundation.

Another possibility would be to slip something under the foundation and then lift it, like a fork lift. The foundation would not have to come completely off the ground but it might stick enough to the prongs that it could be dragged.



After looking at the options for rotating a longer extension system, I explored using a fixed horizontal system. This would he far more simple than the alternative and it might work.

Practice 7-10/18/19-Frame Designs and Horizonal Slide

Luke and Kenny met and met over the some frame designs and developed a prototype for a horizontal linear slide using the rev extrusions.

Kenny rigged the reverse direction using the inverse of the forward direction. It would look like this…

The motor was then mounted to a medium motor for testing. It was not clear if the linear slide system would stand-up to the forces of dragging the foundation.

There is an inherent direction to the slide, based on the position of the slider cushions. I think I mounted everything in reverse when I placed it on the robot because it burst apart under the pressure.

I will have to re-do everything, including the rigging and pillows, in order to make sure that everything aligns before testing. I will also place a directional arrow on the device to make sure this does not happen again.

The problem was that the motor went in the wrong initial direction, which allowed the sections to pop-out. There has to be some mechanism placed to stop the system from running in the wring direction.

Everything was mounted correctly. Things happened too fast and without the video to document the disaster. Also, one of the pillows had no screws to keep it in place.

When I re-assembled the system, one of the anchors was placed on the wrong section. This may have caused the problem.

Fishing lines stretches, which seems to store elastic potential energy. This could be a problem is the line is round too tight. The horizontal slider appears to require a great deal of force to move.

Once I had everything rigged again, and tightened down, I conducted another test. The motor, at a setting of .1 power, was not powerful enough to move the slider easily.

I modified the program and increased the power to .5, which moved the slider relatively easily. However, the line needs a little time to gather itself on the axle, which might be building tension in the line.

Also, the mount was placed on the far side of the robot so that the middle materials did not need to be relocated. Down the road, this will have to be addressed so as to make room for the lifer and potential have the foundation grabber with two points of contact.

Next steps

1. Mount hook to slider arm
2. Test extension length with slider arm
3. Program a teleOp that allows the robot to drive
4. Test tension on arm to see if slider can withstand force of dragging foundation
5. Make hook slide in one direction but not the other (maybe lift the whole thing 1-2”)
6.

Practice 8-10/23/19-servo foundation holder and grabber

Luke, Andrew and Kenny met today.

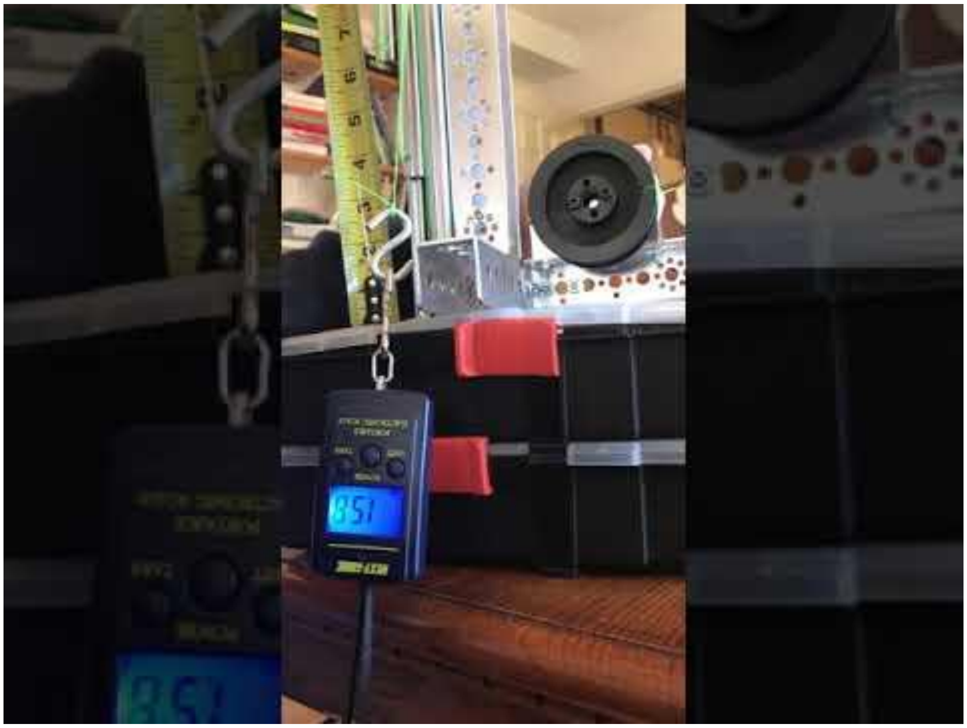
Andrew and Kenny worked on developing a simple servo switch that would rotate to hold the foundation in place. The device was tested by dragging the robot to hold the foundation. There was some bending of the servo, but it worked.

The servo was then programmed and it was tuned and operated successfully.

An opMode was written that operated the mecanum wheels with the old tetrix motors, which worked well. The single mount caused the foundation to rotate slightly when it was being pulled so a second point of contact would be important. This is especially true because the foundation could contact the wheels if it rotates too much..

Luke worked on a grabber for the stones that was connected to the cabinet slider. In order to do this, a medium sized tetrix channel was mounted to the outside stage of the lifter. A medium motor, which the patent pending part, was attached. Luke felt confident that the grippers would hold the stone securely but he did not get to the point where he could do any testing.

Lifter Test Angle 1



Lifter Test Angle 2

Practice 9-11/2/19 Gripper and Rev Cube

(Luke, Kenny and Ethan)

Luke worked on the gripper and finished mounting it to the frame. He tested it using the medium motor and discovered that he could not realized the full motion of the gripper because the cord was too short. A longer cord was ordered to help with this problem.

Luke identified the parts necessary to make a REV cube frame based on the shape of the proto-type three dimension corner. The team needed many more fasteners.

Ethan and Kenny worked on a video on the assembly of the motors using the individual components.

Luke and Ethan met with the FLL team to go over ideas for the Core Values.

Practice 10-11/2/19-mecanum versus Omni

(Luke, Ethan and Andrew)

The team started working on the mecanum wheels to see if they could strafe. They started by modifying the teleOp that Kenny wrote at the last practice. They laid out the motor powers so that the robot would strafe but the robot turned.

Stymied, Andrew proposed that the wheels might not be arranged correctly. The prototype robot was arranged with both left wheels on the left and both right wheels on the right. The team spend a few minutes talking about the two planes-forward/backward and left right.

To correct this, the team swapped the back two wheels.

At this point, the robot strafed correctly but not nearly as nicely as the team remembered the omni wheels strafing. This is a concern because the team knew that programming the navigation during autonomous is very precise and they were concerned that they woul

Luke worked on the fabrication of a REV frame for testing the omni wheels with pulling the foundation. Ethan and Andrew mounted the fasteners to the hardware to make it easier to assemble after Luke cut the REV extrusion to length.

Once the frame was assembled, the new REV motors were mounted to the chassis. The omni wheels were taken from the previous robot and mounted to the new robot.

It was a disappointment that the wheels extended too far forward for the servos to work with a simple switch from robot to robot. Instead, a rev bar had to be added to the tetrix spine in order to get the servos far enough forward to grab the foundation when enacted.

Another issue was that the servos were now slightly higher than before, which required an adjustment to the rev extrusions. Instead of cutting new servo fangs, the group decided to forego full testing of the servos and only test the ability of the robot to drag the foundation with the fangs engaged. The team felt this would save time and materials because there was concern that the omni wheels would not be able to generate enough force to pull the foundation.

The concern over the omni wheels being able to drag the foundation is over the ability of the rubber wheels to slide on the omini wheels. This means that they will naturally lose traction, which is how they strafe.

Another concern is that the motion is at an angle, and not directly in line with the motion of the foundation. The concern is that this will cause more slippage of the wheels.

The initial testing of the drag confirmed that omini wheels might spin instead of dragging the foundation.

Luke wanted to test if the wheels would work with more power, so he modified the program several times and the spinning just got worse.

The team discussed that the tires did not make enough friction with the ground so they proposed adding ballast to the robot. The team decided to place a gallon of milk on the robot to see if the milk would increase the friction between the tires and the ground. It worked and the robot could pull the foundation.

The team then weighed each robot and determined that they were roughly the same. This means that the omni wheel set-up would have to weigh considerably more than the mecanum wheel set-up in order to pull the foundation.

Practice 11. 11/9/19-fixed mecanum wheels

Luke, Kenny, Ethan and Andrew

The team discussed how to best use their time during practice today. They discussed the benefits of making the “rookie” robot tutorials versus working on their own robot.

The rookie robot needs several hours of instruction video support to get the rookie robot program into a position where it can be launched. The team observed a “rookie” bot prototype that used elements of several previous frame designs. The robot had omni wheel castors in the front and back of the robot. The robot used old tetrix motors as the drive motors, which were placed centrally on the robot. The floor of the robot used foam poster board, which can be easily cut with an exacto knife. The robot was light, inexpensive, simple and relatively successful at moving the stones on the field.

The team has several issues to develop relating to their own robot. The team discussed their beliefs about the best way to test the omni versus mecanum wheels on the robot. The team discussed pulling the expansion hubs off of the old robot so that they could use run multiple independent robots without having to move the controls back and forth. The team discussed metrics of how to determine which robot drove and operated better such as measuring percent error with different conditions.

The principle debate was over whether the omni wheels could do the foundation and whether the mecanum wheels could do the skystone during autonomous. Testing in the previous week established that the omini wheels do not have enough friction to pull the foundation. The foundation requires 3.6 pls to drag. Similarly, the mecanum wheels had significant drift when strafing. In the previous practice, the wheels were re-oriented, which improved their performance, but it was still much less compelling that the omni wheels at strafing. The team felt that the poor performance could be due to the old tetrix motors.

Alternatively, Andrew questioned if the mecanum wheels were properly mounted. The team watched some YouTube videos of other teams and proposed that the wheels might not be mounted correctly. Andrew took charge of re-mounted the wheels with the tetrix motors to see if it made a different. The team noticed that the front left wheel seemed to wobble when tested on the jack.

Luke took charge of removing the old REV expansion hub from the old robot. He was careful to label where each motor/servo/sensor connected to the old hub before removing them.

Andrew and Kenny took charge of switching the tires. When the tires were mounted, the robot was tested. It worked significantly better, appearing to confirm that the wheels had not been properly mounted.

The team then decided to use the REV motors from the old robot to see if that could provide any additional gains. This would be necessary for testing because the tetrix motors did not have any encoders so that would not be easily used for autonomous.

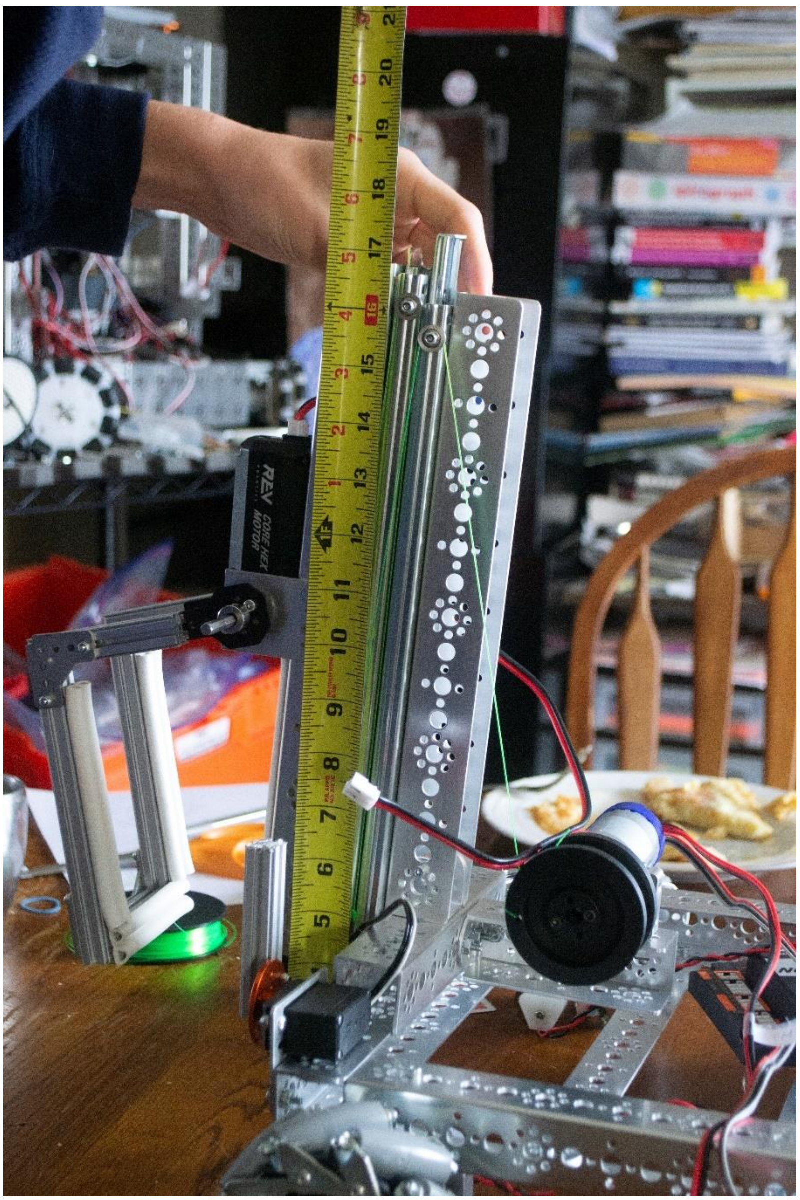
Once the team replaced the old motors with the new motors, the robot was tested again and it worked demonstrably better at strafing.

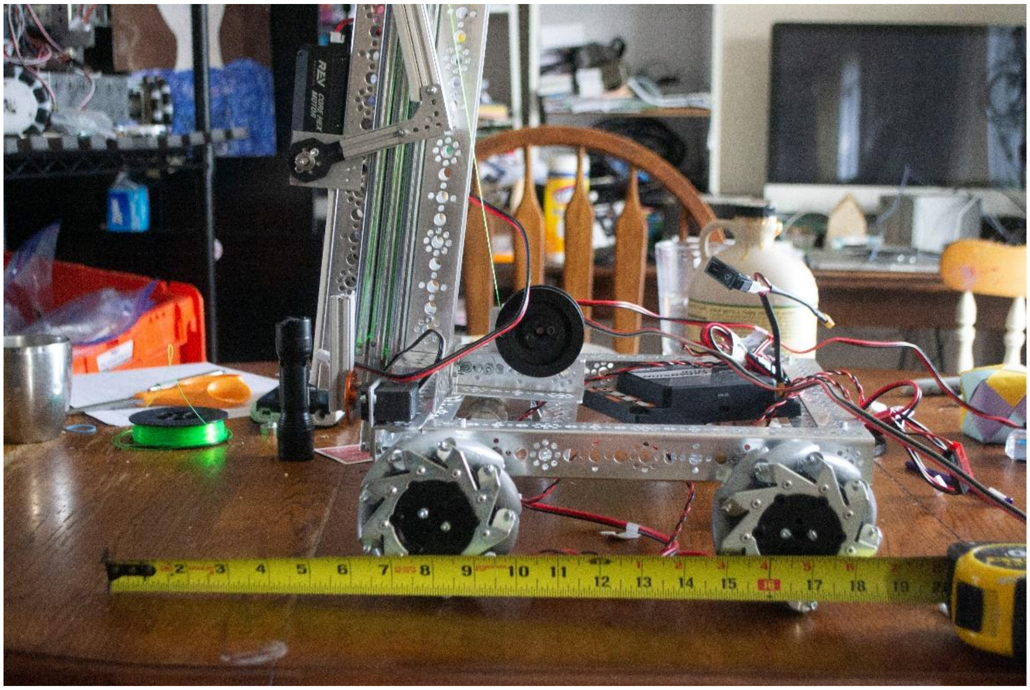
At this point, the next steps for the mecanum robot would be to mount the lift system to determine if any changes needed to be make to its design. There is some concern that the frame might need to be modified to allow the grabber to move more inside the frame because of over-all length issues. There are also like to be some other issues that arise during this testing. During this testing, the team will determine if the gripper can stack stones to their target height.

They will also mount the web cam and to some tensor flow analysis. The team already has some tensor flow opModes but they have not been combined with navigation yet.

At the end of practice, Luke and Andrew worked with the FLL team on driving their FTC robot chassis. The girls had a very good time learning about the more advanced robot.

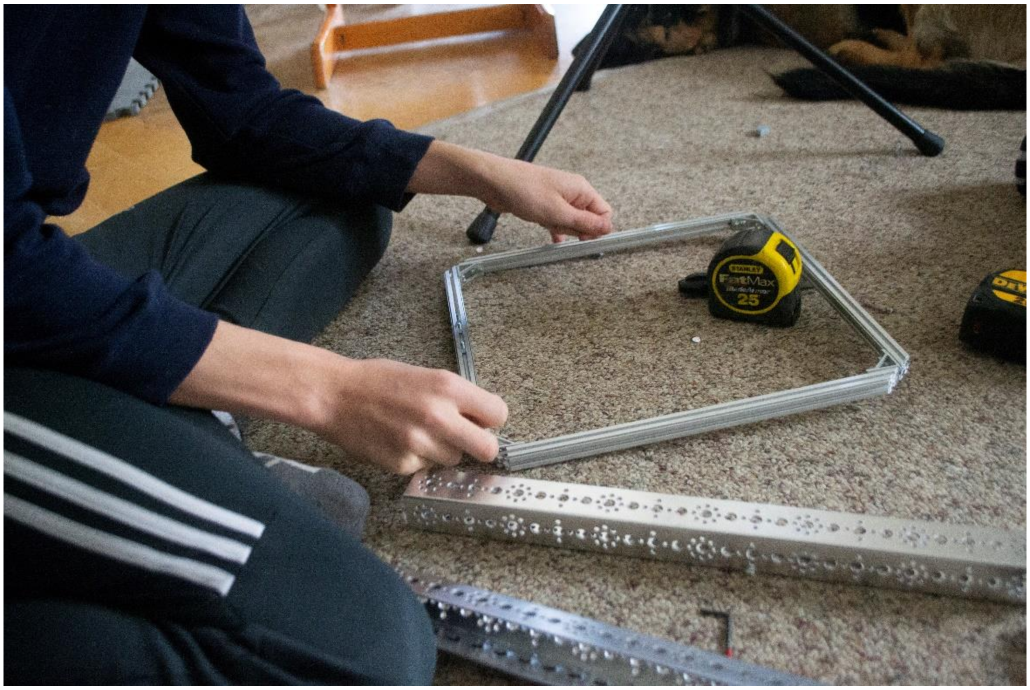
State of Robot-too high to fit under alliance bridge



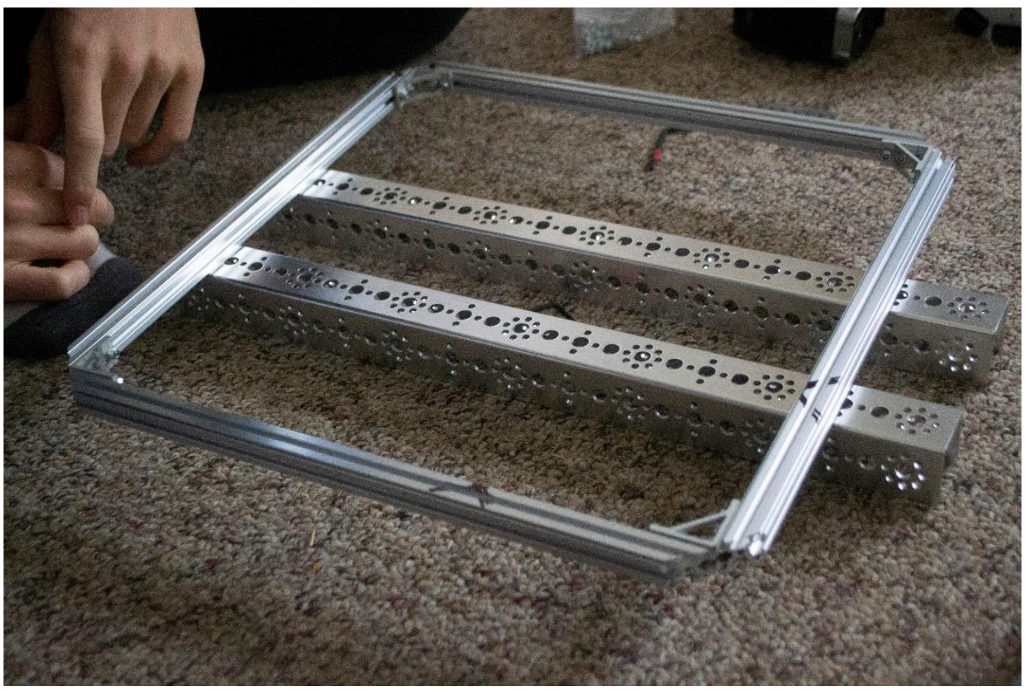


Width Appeared OK

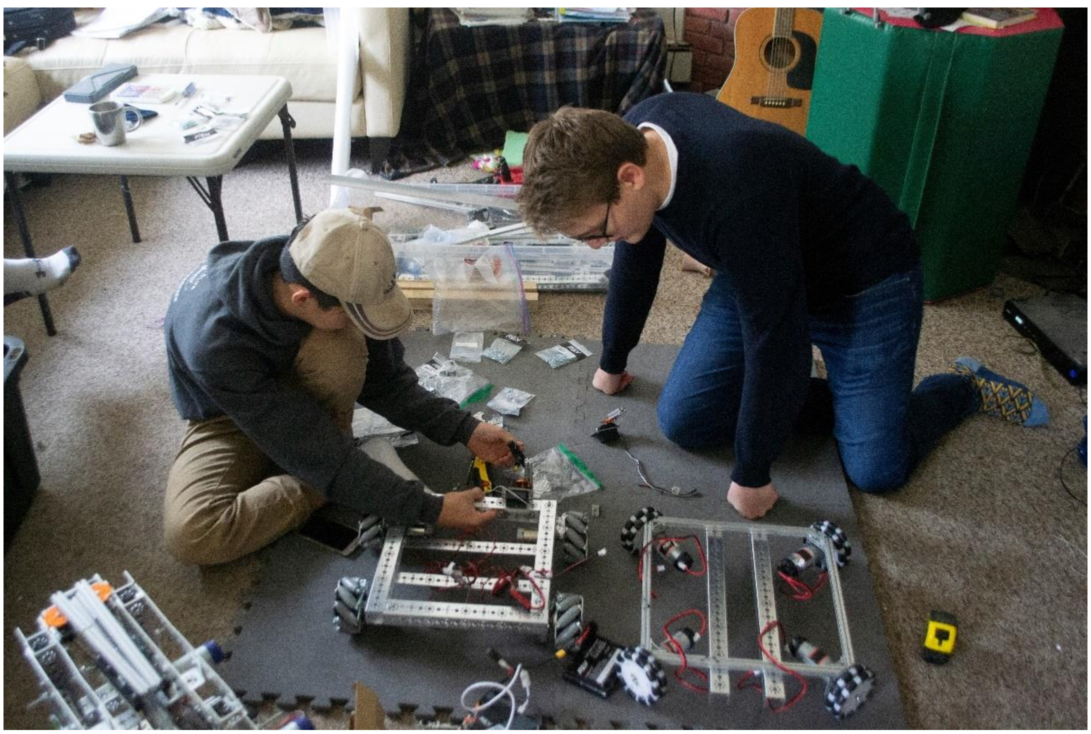
Luke working REV Frame Components



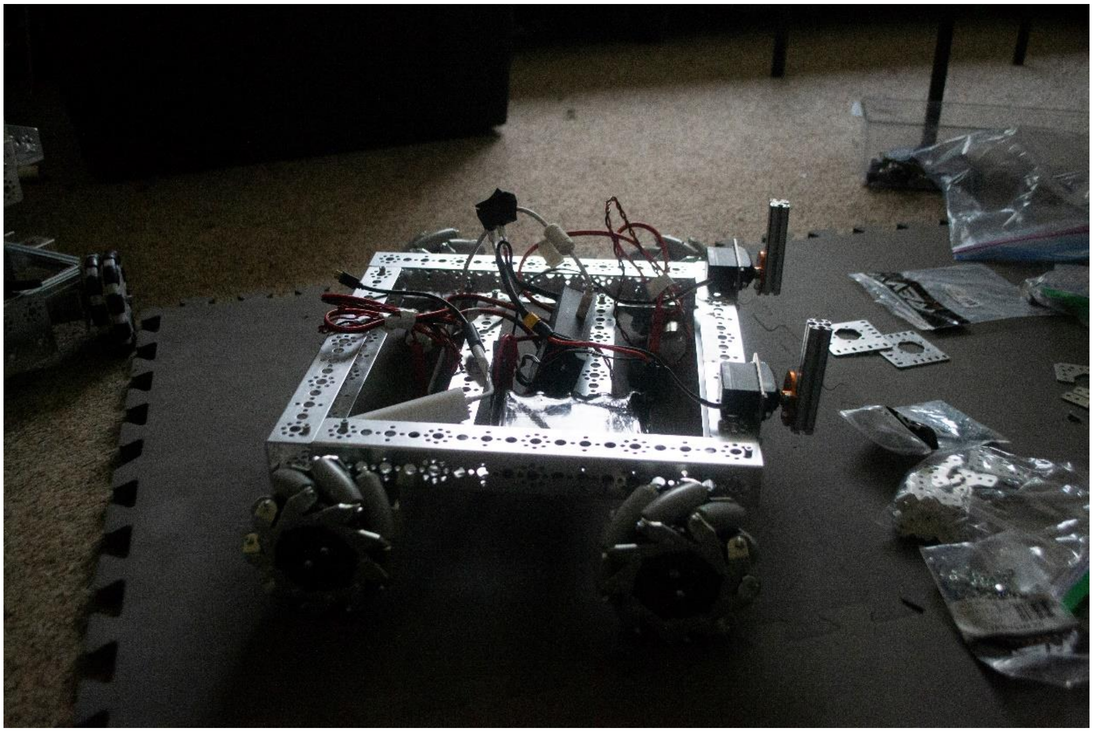
Outline of REV Frame for Omni Wheels



REV Frame with Tetrix Spine for Omni Wheels



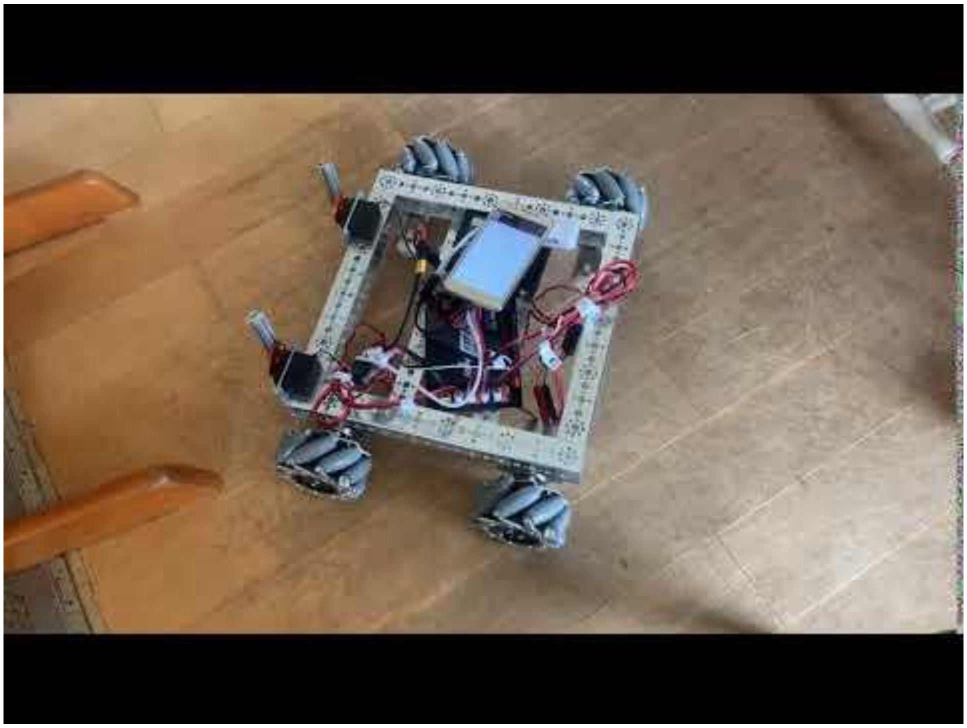
Andrew and Ethan Mounting Servos in Tetrix Frame-Finished REV Frame in View



Tetrix Frame with Mecanum Wheels and servo foundation holders

System Demo on Jack

Mec Troubleshoot V1

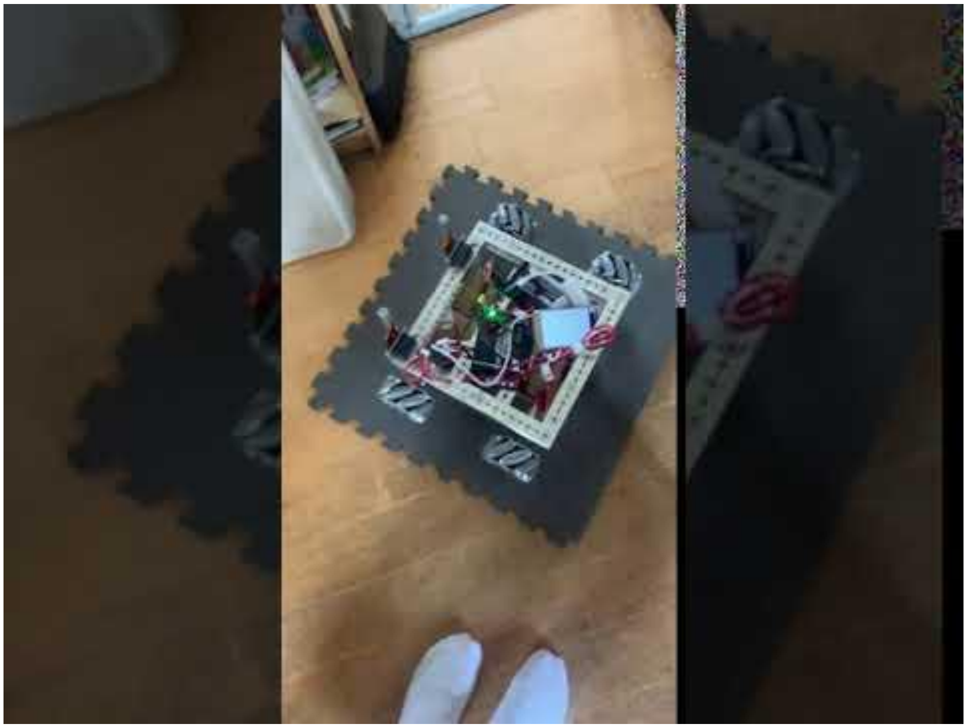


MecTroubleshoot v2

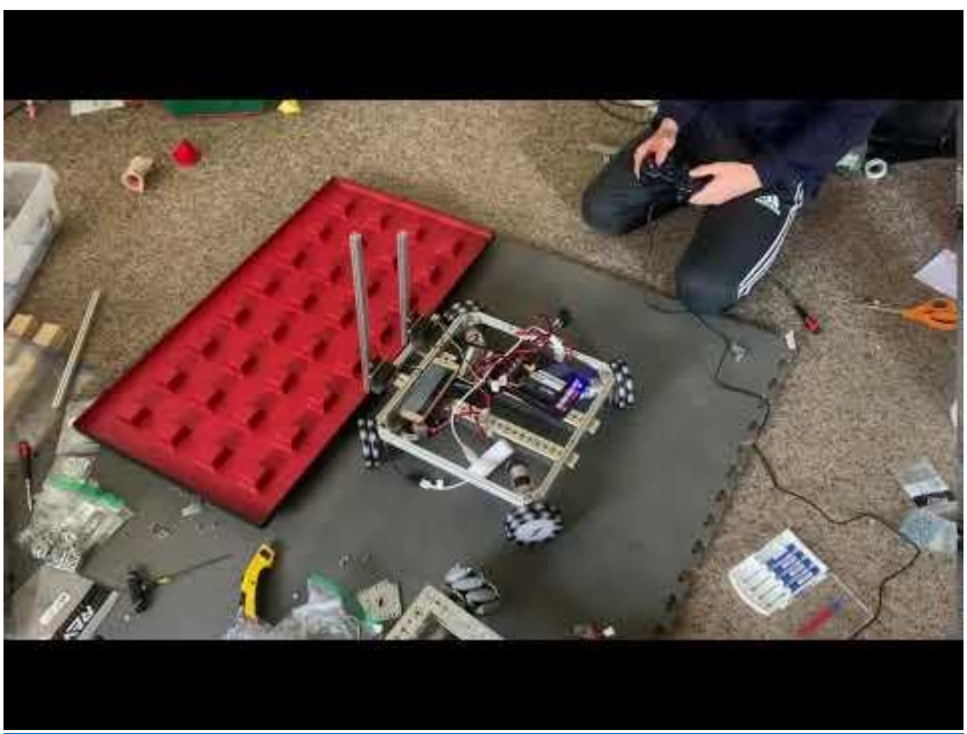
MecTrouableShoot v3

MecTroubleSHoot v4

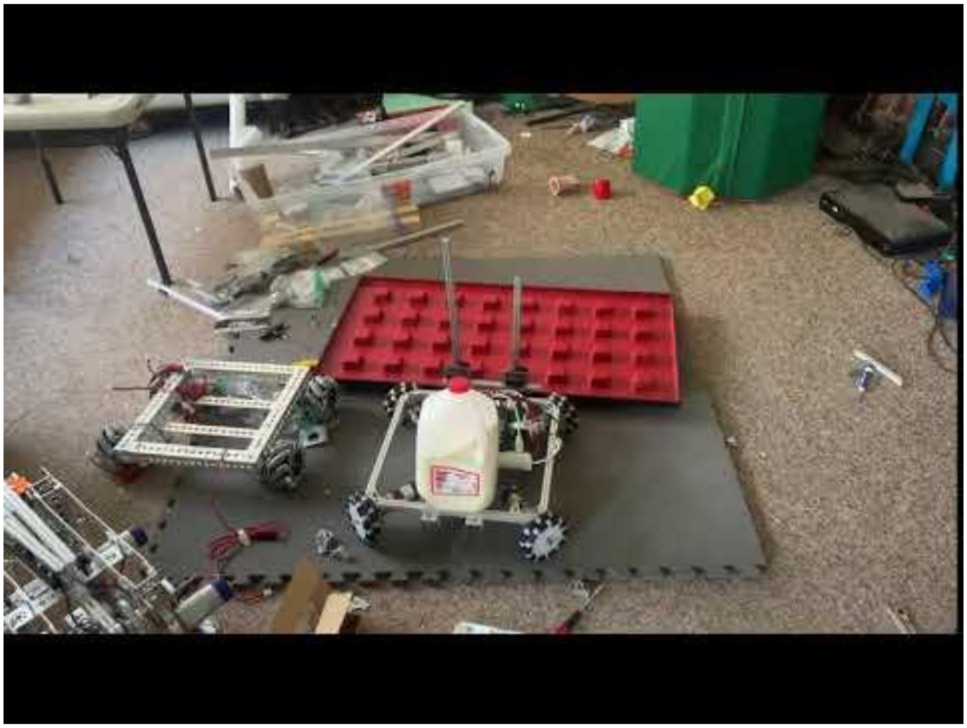
MecTroubleShoot v5



Demo spinning Wheels



Demo with Milk

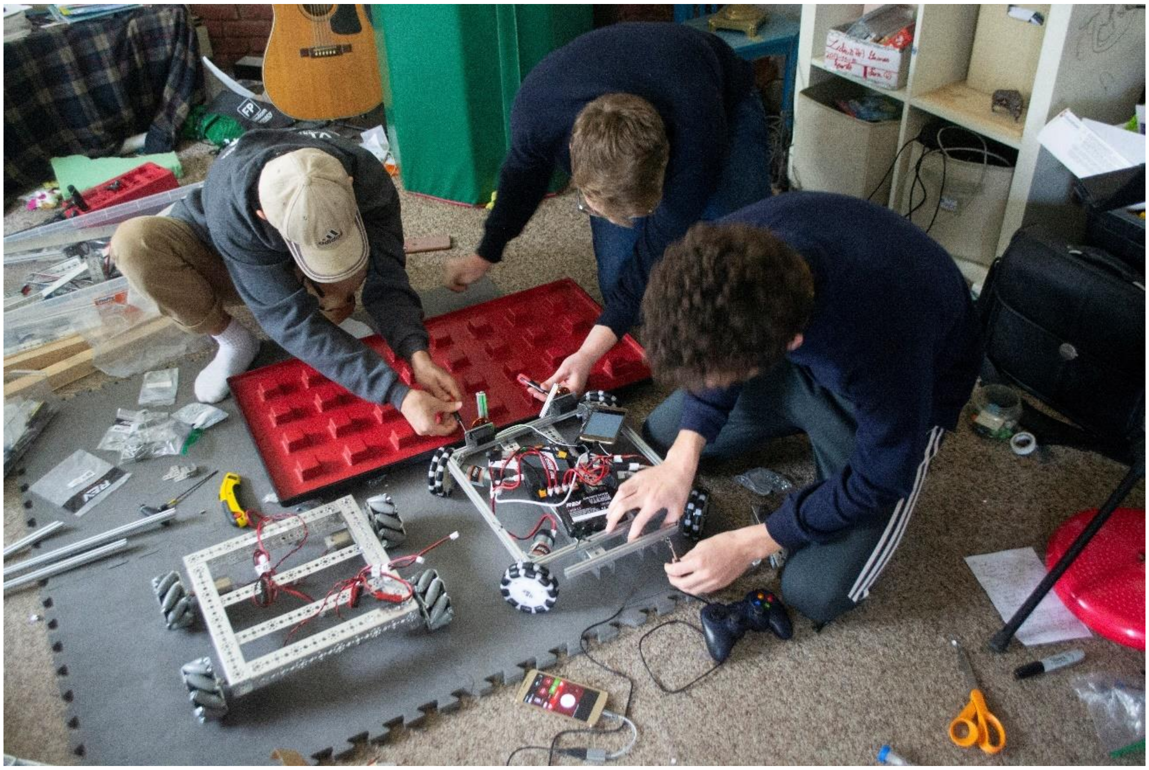


Next Practice

1) Make a rev/mecanum chassis with tetrix spine.
2) Mount lifter/gripper to mecanum chassis (might need to do some modification of chassis)
3) Write lifter/gripper teleOp-do this while the mount is being completed
4) Test lifter/gripper teleOp
5) Integrate lifter/gripper teleOp with mecanum Drive teleOp
6) Test grip/lift/drive with stones

Practice 12-11/26/19-Rev frame, tetrix spine, mecanum wheels

Luke and Kenny met yesterday and transferred the mecanum wheels to the omni frame. They also replaced the rev extrusions so that they faced the correct orientation for the mecanum wheels.



In the process of doing all of this, they also mounted the gripper/lifter to the frame. This process revealed that it takes nearly 3 hours to run over the motors, frame and other mechanical systems.

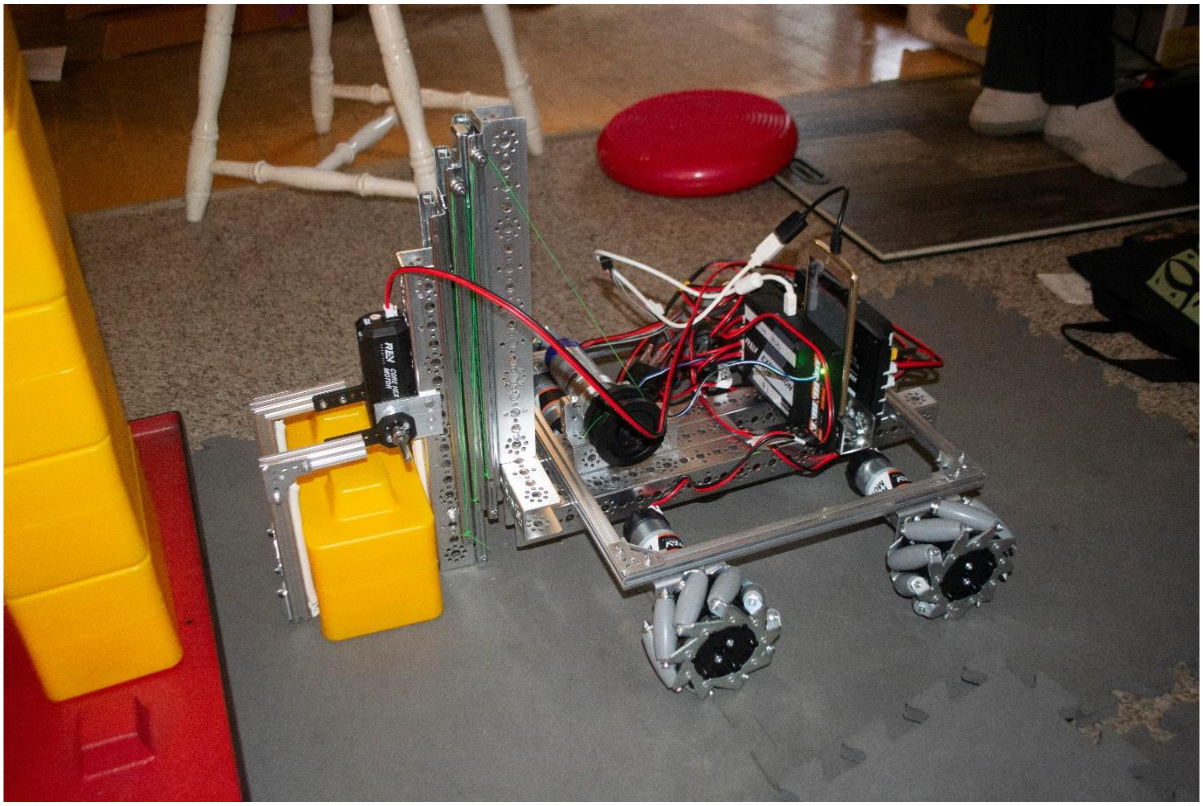
Getting the mass of the chassis

Practice 13-11/27/19 Gripper Lifter Testing

Luke, Ethan, Kenny and Andrew were at practice today.

Ethan and Andrew worked together on the physics of the foundation.

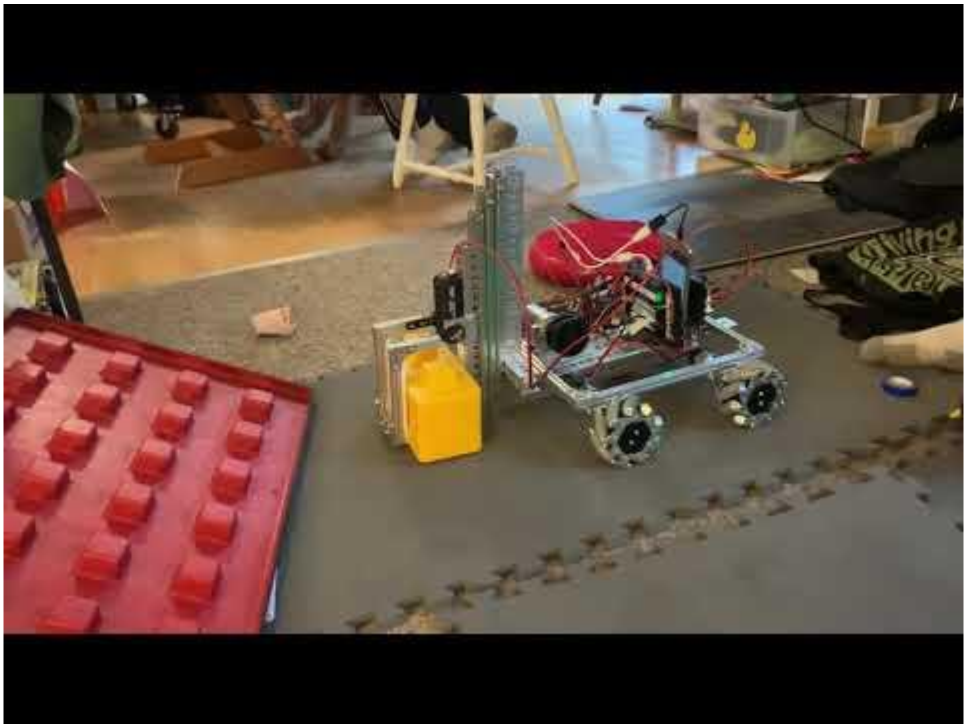
Luke and Kenny worked together on the gripper lifter testing. When the mount was fully assembled, the team tested the mount lifting a stone. The stone went about 4-5 stones high before it maxed out. The system was very far forward, which made the lifter unstable on the frame.



Lifter with Spring scale 1

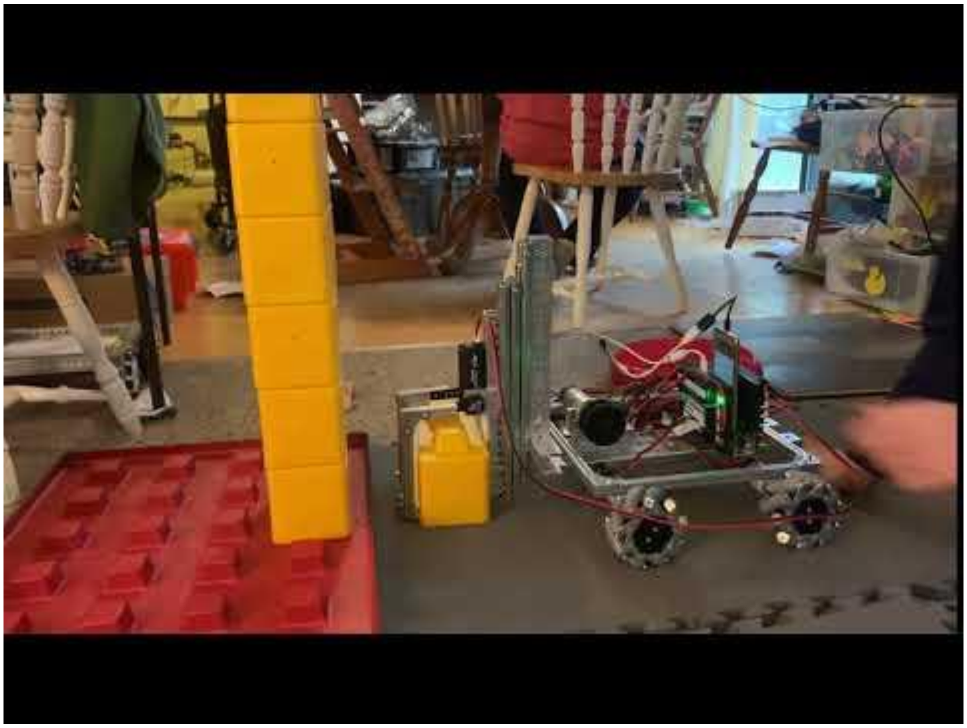
Lifter with Spring Scale 2

Lifter/Gripper on Bot test 1



Lifter/Gripper on Bot test 2

Lifter/Gripper on Bot test 3



Lifter/Gripper on Bot test 4

The lifter was very fast, however, which was good. There was concern about whether it could hold its position when in use. There is concern that the stone and the rest of the materials are too heavy for the motor to hold itself.

The team broke into two groups to explore other frame options. The spine of the REV frame was too far forward so a decision was made to convert the rev frame into a H style frame. Toward this end, Luke cut a cross bar from REV extrusion material.

Ethan and Andrew removed the forward bar and replaced it with the bar that Luke made. The team reflected on the fact that REV frames require some pre-planning because everything needs to be taken apart in order to add something new.

Kenny worked on mounting the lifter to the former mecanum frame. The lifter attached with relative ease.

At this point, the two chassis have not been tested. That would be the goal for next practice.

However, it would appear that the team will need a few more long and medium length tetrix channels and at least (1) probably more, switch connectors from REV.

The team is also working on the vertical space of the robot. Based on the last mount, the robot is too tall to pass under the 14” bridge. There are a number of ways to address this issue such as mounting the lifter lower. This presents the obvious trade-off with height to lift stones.

There is also the issue of horizontal extent and pushing the lifter system across the foundation to place stones deeper into the foundation. This would be addressed with a rack and pinion system or another pulley system.

The lifter needs to be braced in the vertical plane. The team could use flats to brace the channel or they could use vertical U channels. The use of cross braced U channels is probably going to the strongest approach and the easiest to manage.

The team may begin to think about creating a system of channels in the base of the robot that would act like holes, which would allow vertical channels to be placed inside them.

Practice 14-12/7/19 Rev with smaller spin

The team tested a new design using the rev extrusion system with the smaller spines. The assembly was tested near the end of practice and the string supporting the lifter broke.

Lifter Test V1

Lifter Test V2

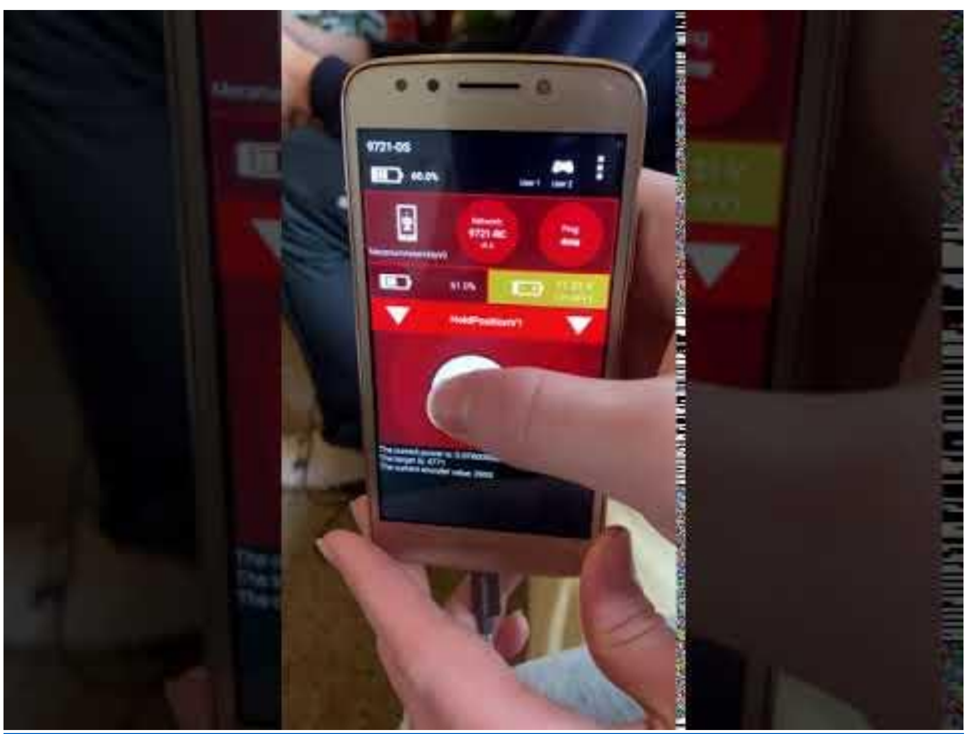
Practice 15 12/15/19 Lifter Can't Hold Positoin

Luke, Kenny and Andrew

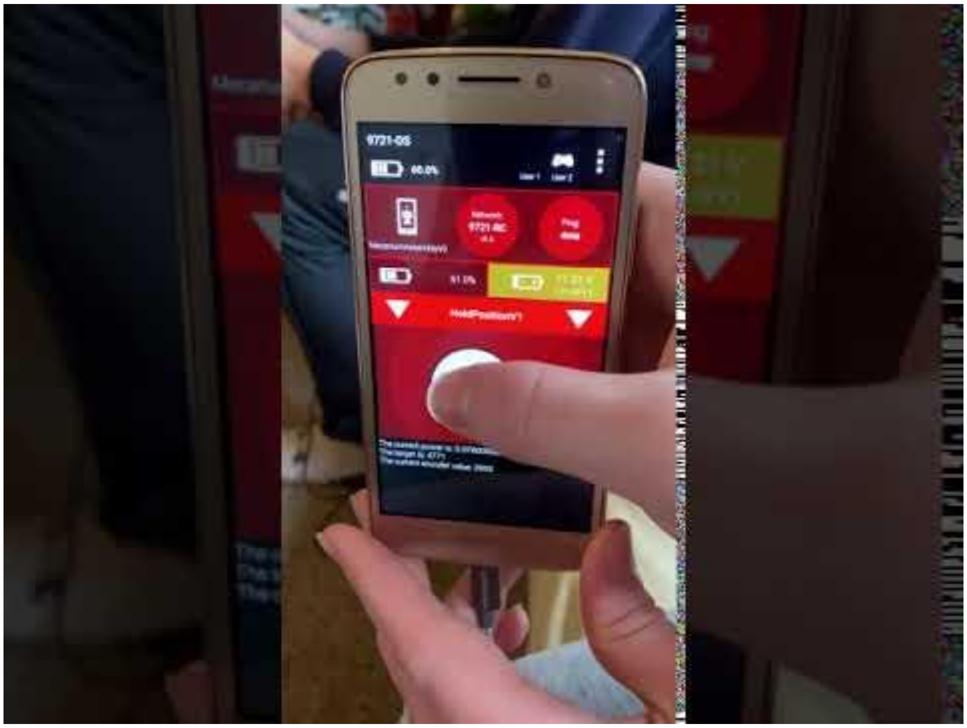
The team re-strung the lifter using the braided 50-pound fishing line. The system was tested and it was determined that the lifter could not hold its position.

Can’t Hold Position Telemetry 1

Can’t Hold Position Telemetry 2

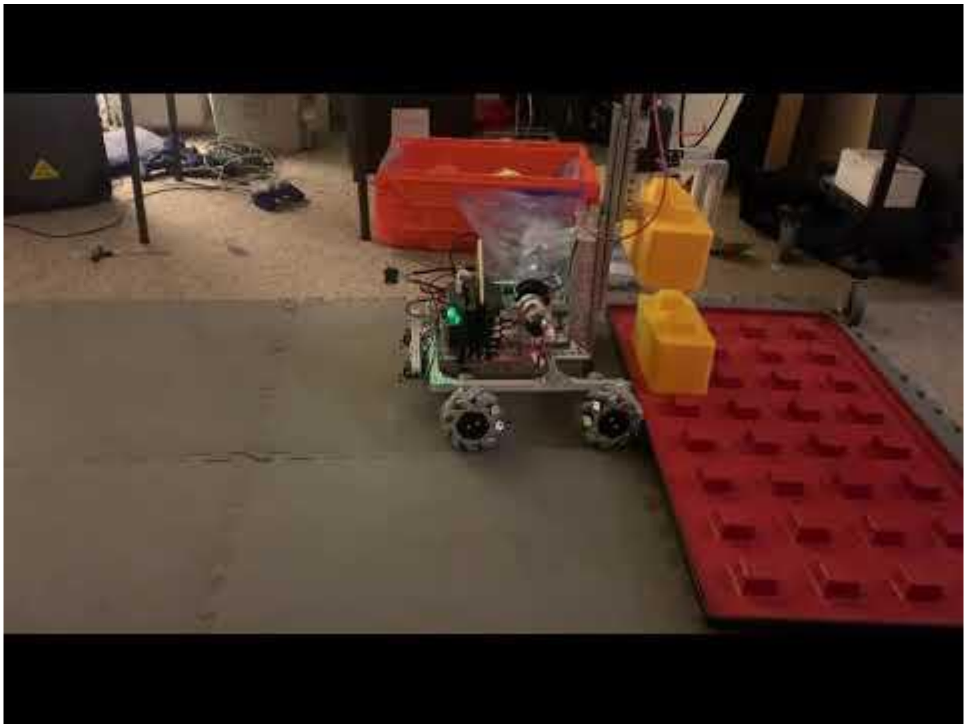


Can’t Hold Position Telemetry 3



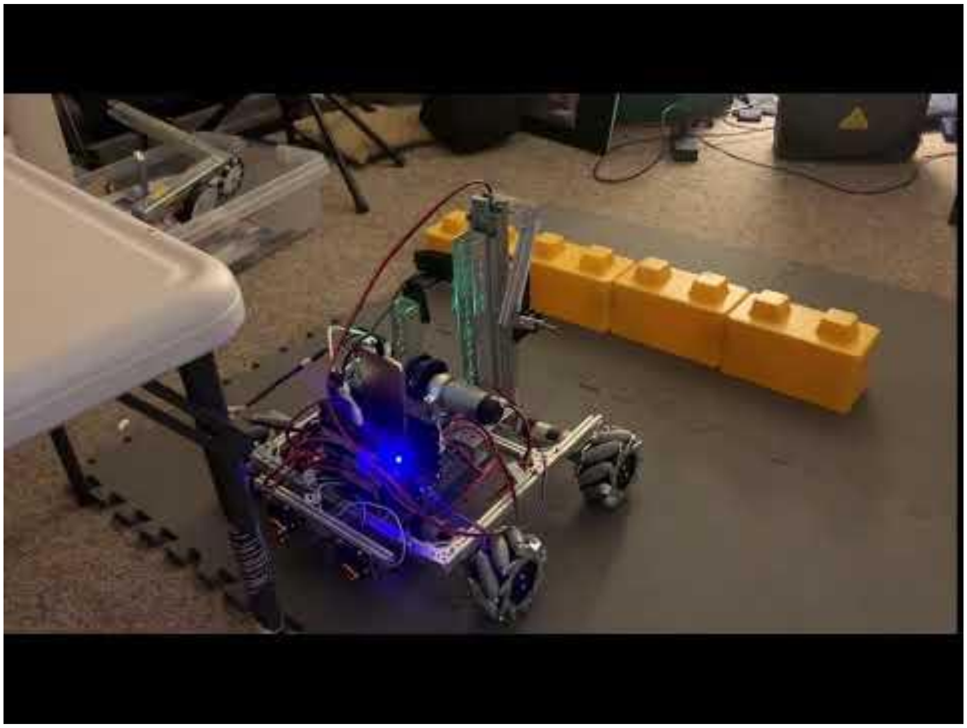
Can’t Hold Position Telemetry 4

TeleOp 1

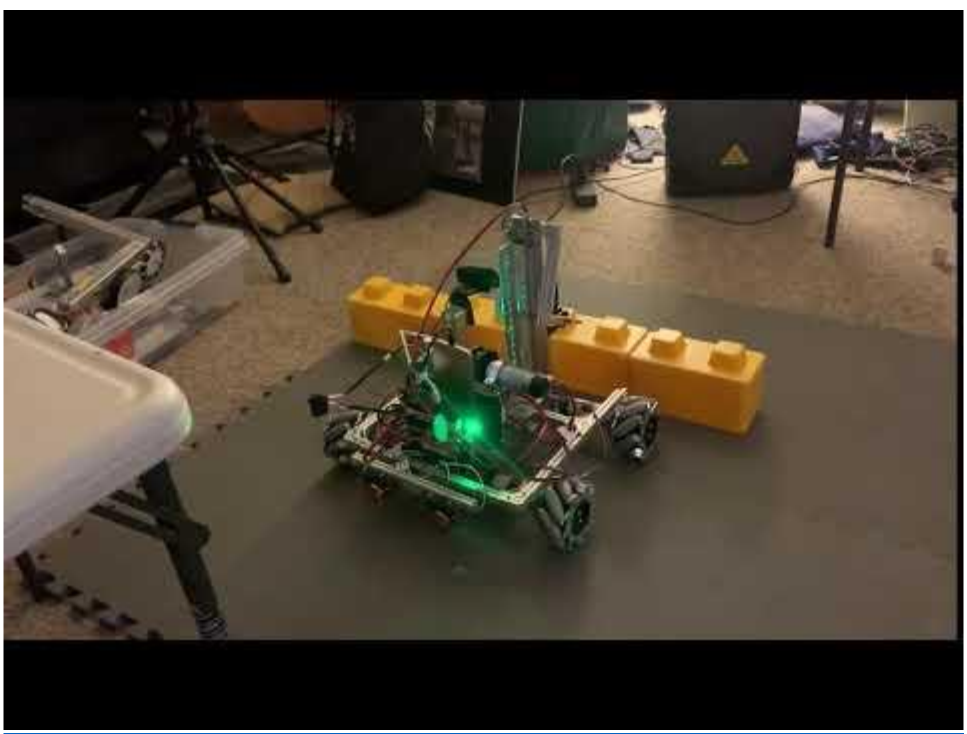


TeleOp 2

TeleOp 3

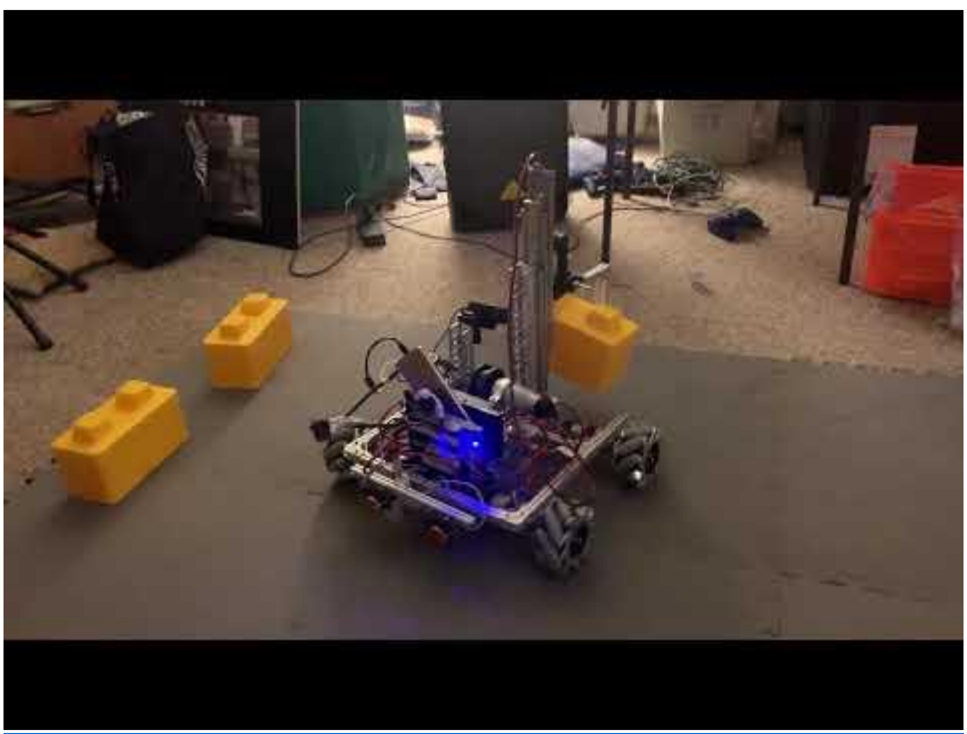


TeleOp 4

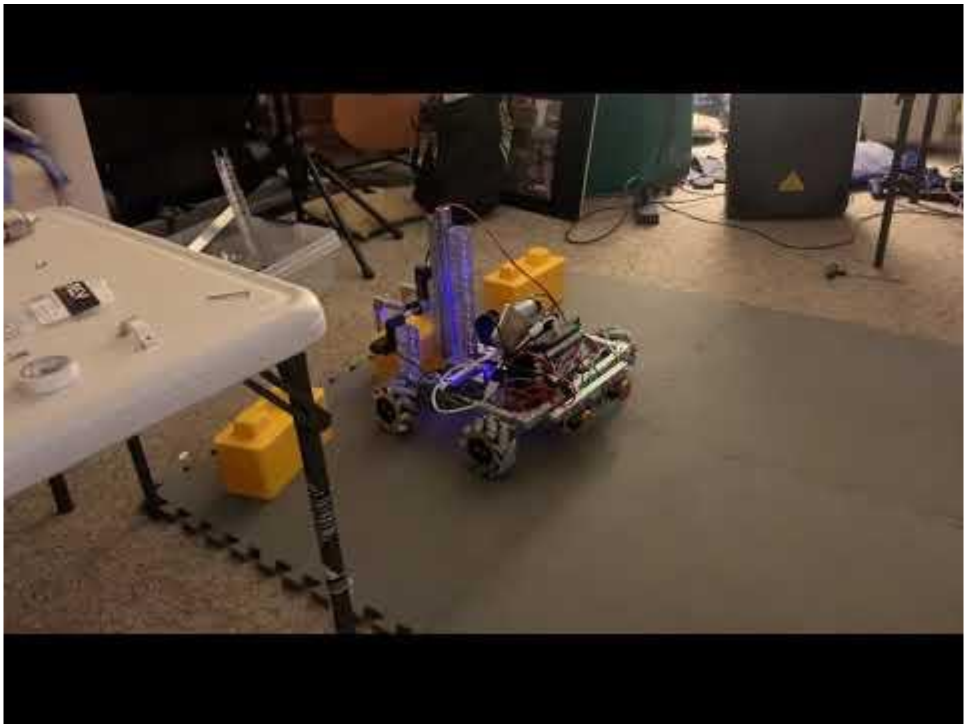


TeleOp 5

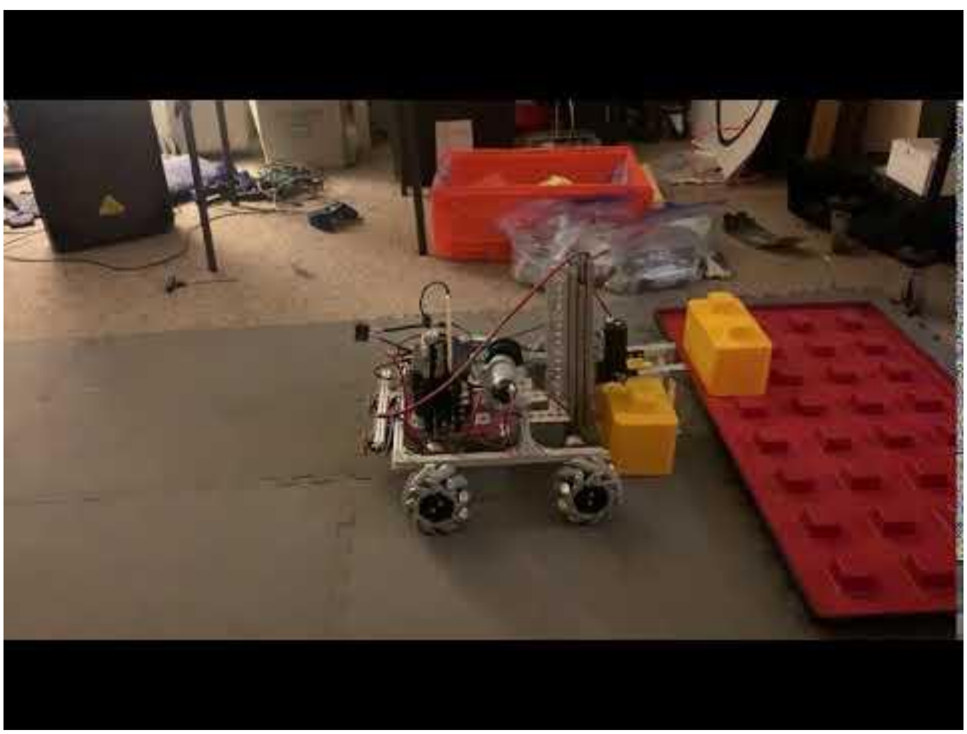
TeleOp 6



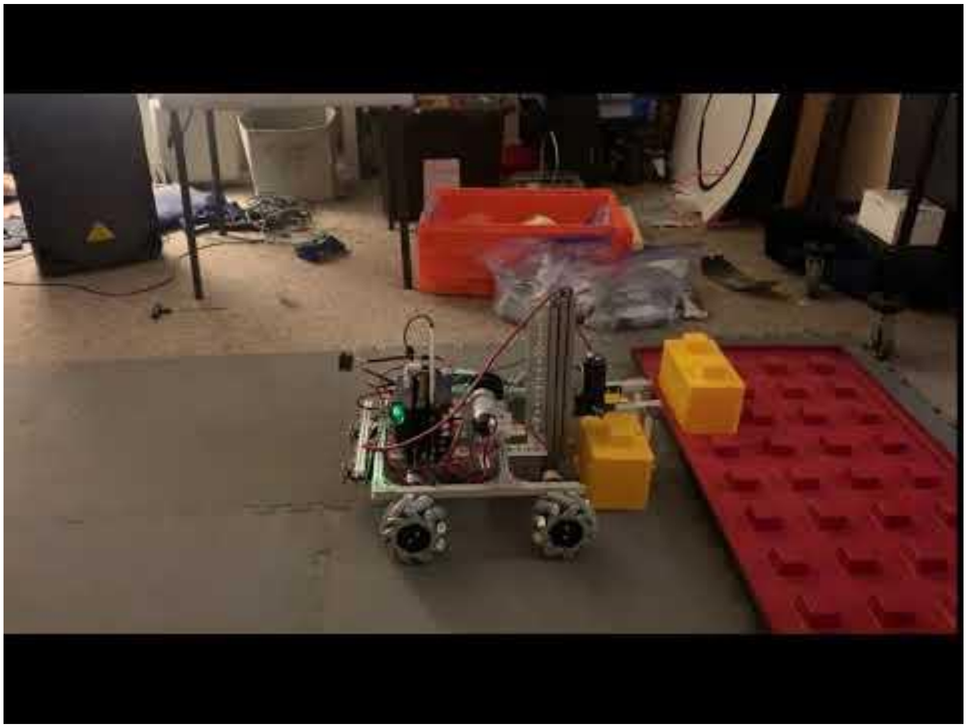
TeleOp 7



TeleOp 8



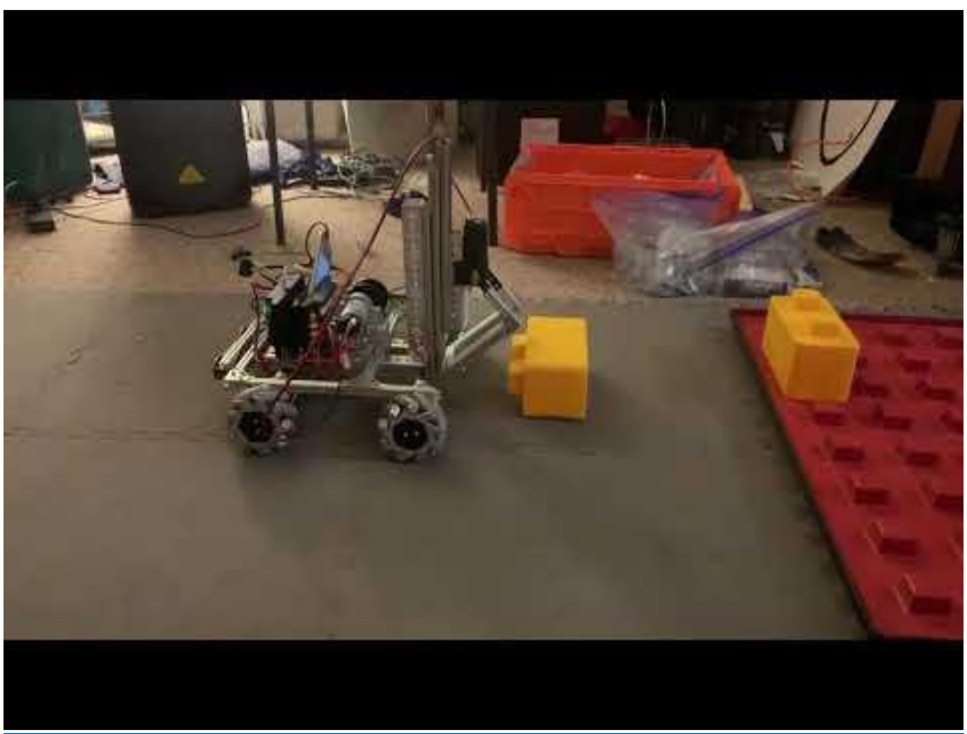
TeleOp 9



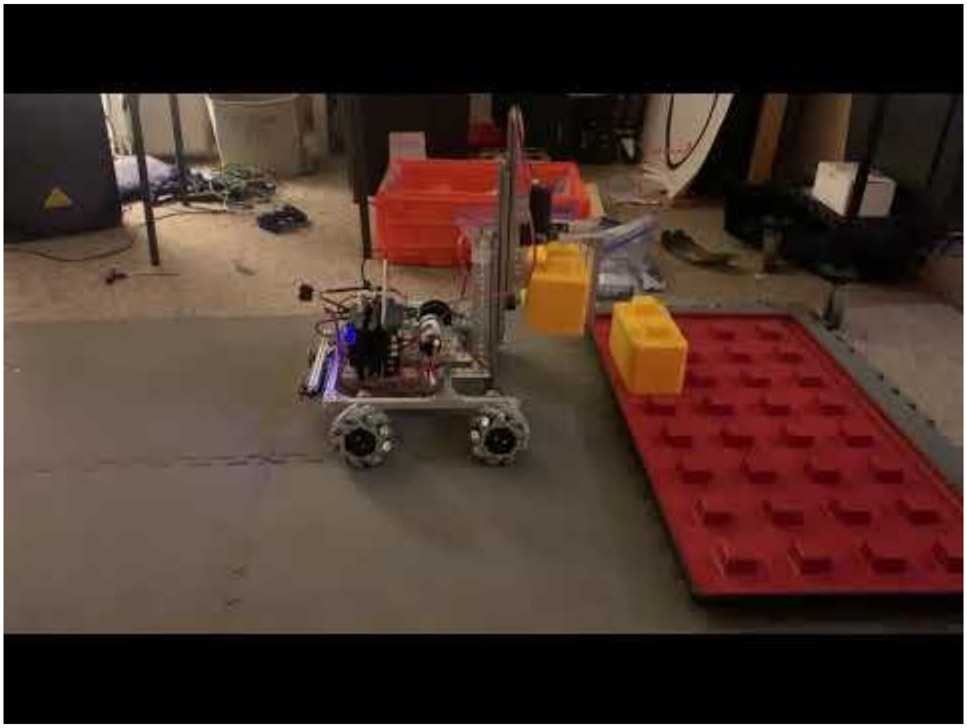
TeleOp 10

TeleOp 11

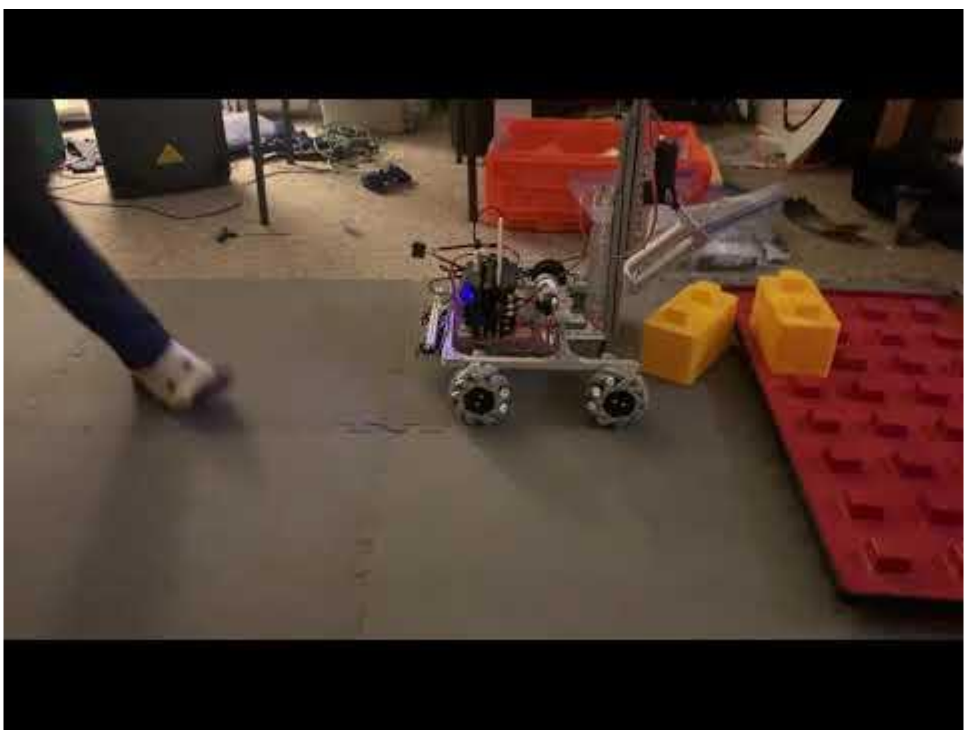
TeleOp 12



TeleOp 13



TeleOp 14



The team discussed several different ways to manage this problem. First, the team considered some mechanical fixes. The long channel that holds the motor could be replaced with a smaller channel. This would reduce the weight.

The motor could be replaced with a servo that light be lighter and still strong enough to hold the stone into position.

The system could also mount the motor directly to the lifter, without the channel. This would reduce the length, overall. This would reduce the force needed to be exerted by the motor because of the lever effect of the distance of the stone from the pivot point where the forces are applied to lift the stone.

Andrew worked on the mechanical solutions and replaced the channel and did some testing with the braided line.

Kenny and Luke worked on the software solution. First, they made a method that would be called when the up pad was no longer pressed. This method would set a target height for the lifter and then apply more and more force until the target height was attained. The target height was measured using the encoder.

This created a problem because the motor over-shot the target height and broke the string. This happened because the program took longer to ramp down the power than it took to ramp-up the power. In other words, the lifter did not slow down fast enough.

This was corrected using a recursive algorithm where the power was reduced by half if it overshot the target. This resulted in a somewhat stable system where the lifter would lift the stone to a height, and they it would lower slightly.

Luke then integrated the whole software system together but there was a problem. Several statements were redundant. This was not noticed because the code was too complex to easily understand. The team then broke the code into smaller pieces in order to make it easier to manage. The redundant code was removed.

Then, everything worked. During the initial testing of driving and operating the lifter, there were problems. The lines easily came apart. It was not totally clear how they came apart but it is reasonable to assume that they gained slack when the lifter was lowered because the process is erratic and not smooth. Whatever the reason, the system failed each of 5 consecutive times. During each effort, the lifter got close to operating correctly but it did not complete the task.

The power line to the medium motor on the top of the lifter got stuck on the mecanum.

During this process, it became clear that the lifter is very sensitive. This is because there are many ways to create slack in the system, which causes it to fail. One of the obvious sources was that the channel would hit the stone. When this happened, the motor would continue to lower the other sections and create slack in the system.

The REV keepers could be added to the system. This could make an improvement in the design of the system. An initial investigation of this approach revealed that the longer bolts might be required to allow the whole thing to be assembled. This would require taking apart the entire system in order to access the fasteners and maintain tension.

The rigging of the system could be changed so that it was less likely to fail when the system is on the extremes. At the moment, when the lifter is all the way down, there is slack in the green line. This means that when the black lines breakes, the green line will pop off.

The black line appears to have problems catching the screws on the motor hub. This cause the system to operate incorrectly. There are several ways to address this, at least potentially. We could potentially use the REV pulleys.

The rigging could be replaced with the REV line to see if that helped it operate better. This line works better with the REV pulleys. The largest pulleys could help maintain tension on the line.

There are many ways to proceed with resolving this issue. Perhaps the most simple is to sacrifice some of the total lifting height for the rack and pinion, which is a more stable system. It should hole position easily and it should be simple to operate under the conditions at hand. It also has a geometry that fits better with the other components.

It might also be time to look at the REV linear slide system with the return. That system can be worked into smaller sections to potentially outperform the tetrix system that is slighty lower but more robust.

The robot also seemed very slow when in operation. The team should look into adding more power to the robot to increase the speed.

The preliminary dimensions appear good. The robot is low enough to fit under the bridge and it is not longer than 18” in the horizontal dimensions.

The web camera was mounted to the front of the robot.

Bonus Time

Fabrication of Lifter once the Post is Installed

The lifter has three stages, defined by the large sections.

The first stage is fixed to the post. This stage uses rigging to run from the motor, through a pulley, to the bottom of the second stage. Since gravity will easily return this lifter, the left side will be used for the motor.

The third stage will be connected by an anchor at the bottom, which will pass through a pulley at the top of the second stage, and to another fixed anchor on the first stage. By placing this on the right, the pulleys will not interfere with each other. This makes it possible to use larger pulleys, say for example a laundry pulley.

Assembling the stages is a complicated procedure. The First stage and second stage should be mounted together before mounting to the post. The sliding stage will allow for both to be mounted to the post easily.

Next,the pulley needs to be added to the base of the first stage. This is because it can be difficult to access once the second stage is added.

The pulley can then be added to the other side of the second stage. Once the pulley is attached, the second can be inserted into the first stage.

At this point, the final stages can be assembled and then rigged to the first and second stages. Finally, the grabber can be mounted.

Programming

Some changes need to be made to the programming.

First, there is an absolute limit to the behavior of the motor. If the motor goes too high or too low, the system will fail. The peak and bottom can be determined in a prepared trial. The lifter should be set to the default position and the encoder should be set to 0. This sets the bottom.

Second, when the lift is lowering, it needs to operate more smoothly. The motor power can be set so something slightly less than that the power needed to lift the motor. This will allow the motor to fall smoothly. This value cab be determined by writing a small script that allows small changes to the motor power using a button. Ideally, the team would run an experiment to determine the stall force at each level of power.

Once the minimum amount is determined to lift the device, slightly less than that can be applied to lowering the lifter.

When the system was tested, it worked well. The lifter was much smoother and the lift could reach the maximum height. Moving the pulleys to opposite sides appear to be a good idea. However, the system collapsed when the motor line snapped. This has been a persistent problem.

The lift was re-built using the rev orange chord. A spacer was added near the pulley to help it make a better connection to the cabinet slider. This version was tested and it operated much better than the previous two versions.

Moving forward, it might make sense to explore using the insert connector and the laundry pulley wheel.

It seems like the medium motor will need more power.

--

The system was re-tested and it performed very well with some noticeable issues.

1) Luke noticed that when a button is being held on gamepad2, gamepad1 becomes unresponsive. This can be worked around but it is really important to identify the issues.
2) The robot cannot place a stone in a stack once it falls over. I don't think this will be a goal to be overcome. I think this may be an issue the team may face.
3) The gripper holds the robot against the back of the post. The stone needs to be slightly more forward in order to align with the stones that have already been placed. This might mean that the gripper needs to be adjust slightly, in order to allow it a little more reach to make-up for the extension of a holder inside the post to the gripper. This should allow a consistent placement of the brick.
4) The nut on the motor pulley came off during testing. This nut could be secured using the red heat glue or another fastening technique. Perhaps a tie could be placed on the end to hold it in place.
5) The gripper needs more power to hold the stone in the air. (5-10 minutes)
6) The robot is way too slow to operate multiple runs at this time. (5-10 minutes)
7) The lifter motor needs to have multiple points of attachment to hold its position better. (20-30 minutes)
8) The foundation grabbers have not been tested since they were added to the new foundation. They need to be tested and likely adjusted and checked for over-all length. (an hour)
9) The tensor flow camera mount needs to be tested and adjusted. (an hour)
10) The phone mount needs to be tested and adjusted. (10-20 minutes)
11) Distance sensors need to be added to assist in development of Dead reckoning methods for axial, strafe and rotation (2-4 hours in a single session)
12) Black box methods need to be developed to determine how to remote control the encoder data to repeat for autonomous. (2-4 hours in a single session)

Capturing and delivering stones

1) Lower lifter as low as possible
2) Close grabber around stone
3) Lift stone as high as possible (otherwise, you might have to repeatedly lift the stone
4) Once the stone is in position, lower the stone onto the stack
5) Release the stone

Might want to add some markers on the robot to help center the robot when driving at weird angle

Script for dialogue regarding more this way or that way or I trying this or that

Autonomous Robot Avoid (double outside loop for time and encounters with other objects)

1) Run a major loop that takes into account information from either a ultrasonic sensor or a distance sensor. This sensor(s) could be mounted to a servo to move in order to collect more information.
2) If something is detected, determine if it is moving and whether it is going to remain an obstacle.
3) Make different decisions based on the time allotted

1) There are only (3) random starting positions for skystones
2) Robot must be touching wall on driver side of station
3) May not be in scoring position
4) May not be touching another robot
5) May not be in depot
6) Must carry stones under the bridge cannot be at full extension (might want a pushed type of plow in the front)

The foundation holders were tested as mounted by Andrew. The new position had several issues that needed to be corrected.

1) The position of the servos horn made contact with the foundation.
2) When the rev extrusion slide, because of servo action, it hit the edge of the foundation and pushed the robot up
3) The servos rotated on the interior space of the robot making the distance between them smaller.
4) The total length of the robot was slightly over 18”

To correct these issues,

1) the servos was moved directly to the frame of the robot.
2) (4) different servo mounts were considered. Each of the mounts had different strengths and weaknesses. The mount that was selected had two plans of support for the servo. The first plane was in the vertical plane. The second plan was in the horizontal plane and resulted from the servo body resting upon the rev channel. When under a load, the servo would be pushed back as the extrusion is pushed up. The channel prevents the servo from flexing. The other other mount that provided this support was the tetrix mount. However, the rev mount that was selected was smaller and created a smaller footprint for the servos.
3) The servos were mounted as far apart as possible for minimum rotation from the foundation
4) The servos range of motion was reduced to make the operation faster.
5) The servo arms were mounted on the outside of the servo to optimize the distance possible with the servo position.

During testing of the servos, the drive software had the front and back mapped incorrectly. These were corrected.

When tested, the spine of the robot makes contact with the foundation. The spine can be pushed onto the foundation, which is a concern. A bumper of some kind may need to be placed here to present the robot from getting stock on the foundation.

When tested, the robot could approach the foundation, make contact, and then drag the foundation into position.

The next testing of the foundation would be

1) to determine the speed it could be dragged with a stack of 5 stones (4 stones+end cap).

testing on the gripper when the lifter all the way down.

Drive with the gripper in position. Potential change the power of the gripper to hold the stone.

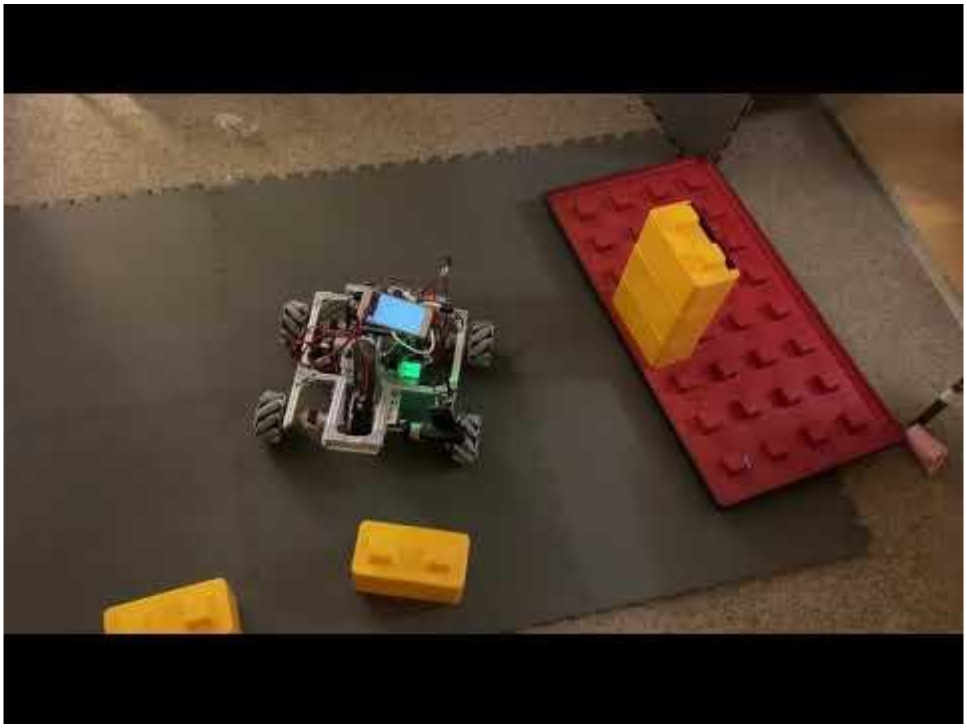
--Detailed Testing of the Gripper

Testing of the gripper revealed some issues.

1) The gripper cannot grab the stone with the lifter all the way at the bottom. This could create a potential problem for crossing on the team side of the bridge.
2) The gripper arms are quite long. This was probably deliberate and made it possible to grab from multiple positions without hitting the stone studs. The length of the gripper arms could be reduced if the arms were moved inside the studs. This would also allow the gripper to hold at a lower position.
3) The grabber/lifter had some coding issues. The motors were set to 0 in the mec all stop. This created a situation where the motors were being shut off if no button was pressed. This made the hold position and other elements challenging because the motors were receiving multiple messages when nothing was being pressed. This could be clarified if the team removed that code from the all stop and created better code within each method.
4) The team has the servo code on gamepad1. The team might want to move this to gamepad2 to make the drive control and the arm controllers totally separate.
5) Add parameters to methods for teleOp drive. This will make testing more efficient when running different power levels.
6) Assemble the field set-up for testing of driving under the barriers
7) Write reports on various sub-systems
    a. Drive system
    b. Lifter
    c. Grabber
    d. Foundation holder
    e. Tensor slow
    f. Electronics
    g. Cap design

Need to explain how to find, use java doc. New programming constructs

State of the Robot



Practice 16. 12/20/19 Full TeleOp Reherasal

Kenny, Luke, Ethan and Andrew were all present today.

Luke modified the mount of the medium motor on the grabber so that it would be higher and less likely to hit the ground when it closed.

Luke and Ethan moved the front wheels back so that the robot could more easily stack stones in the foundation.

Ethan and Andrew worked on a design, using balsa, to act as the cap for the robot.

Ethan and Andrew did a modified alliance bridge to verify that the robot fit under the bridge, which it did.

During testing, the modified gripper seemed to work better for making trips with the robot. The strone did not appear to come loose.

Luke mounted a 2m distance sensor to the robot in order to measure the relationship between power and speed.

Kenny worked on integrating some prototypes methods into the current working method. The biggest change was the use writing data to a file in order to analyze the data using excel. It took the team a little while to check that the motor encoders were wired, which they were not.

This data logging method works as a primitive back box that make entries to the data file each time the robot is run. Currently, the robot over-writes the file with each run.

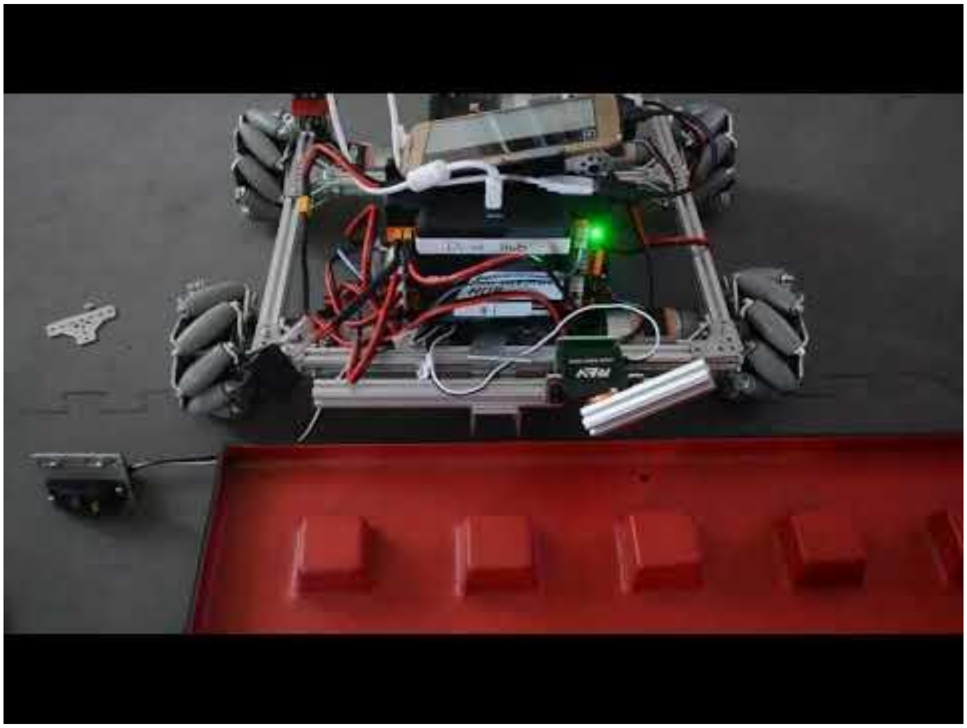
The team measured the speed of the robot at three power levels, .2, .4 and .8. They used these levels because they were double each time. This will allow the team to calculate a maximum speed and the power they need to operate at specific speeds. This could be important for making the run to place the cap.

The team then did several rehearsal runs of teleOp. Everything worked well during the first practice run. The modifications to the robot made things run smoothly.

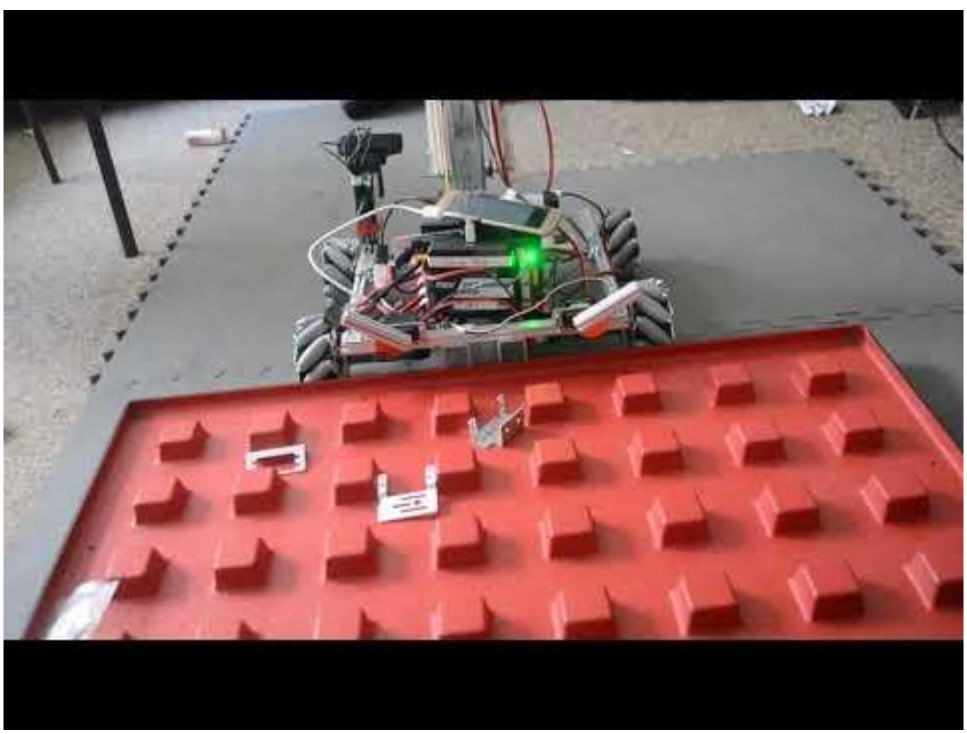
During the second practice run, the lifter got stuck. The fishing line was too fatigued to continue to work so it was replaced with the orange REV chord.

The team appeared confident and positive. The engineering notebook would be the next major piece of time. The team did have some discussions about the importance of using calculus and physics in the engineering notebook.

Foundation test 1



Foundation Test 2



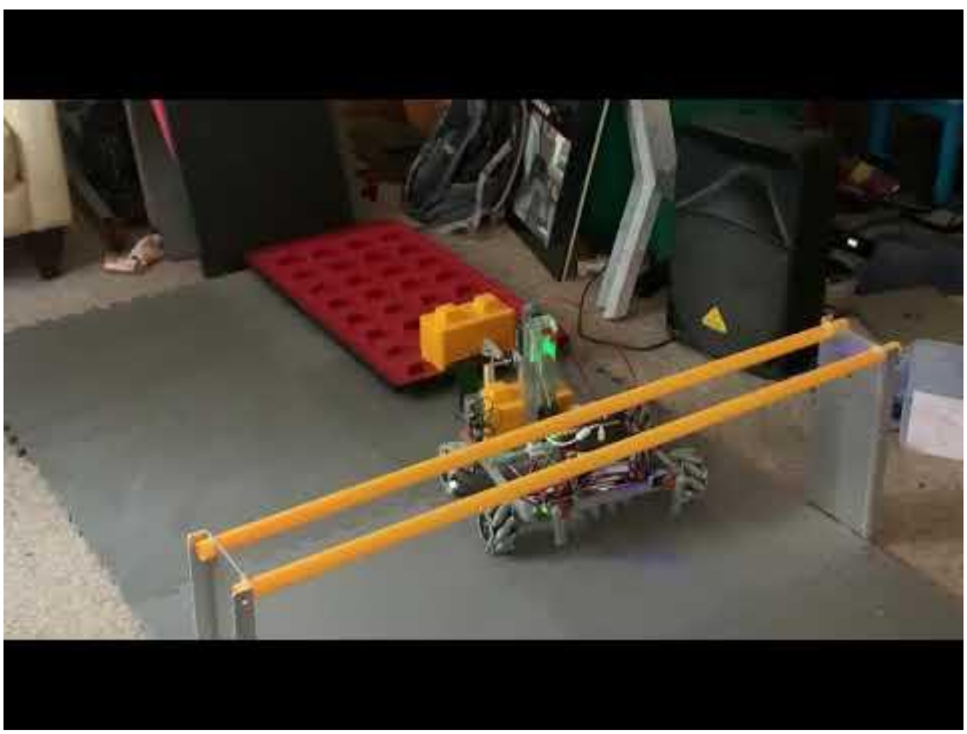
12/21/19

Alliance Bridge Test

Alliance Bridge Test with stone

Alliance Bridge with Stone and Circles

Stack 1



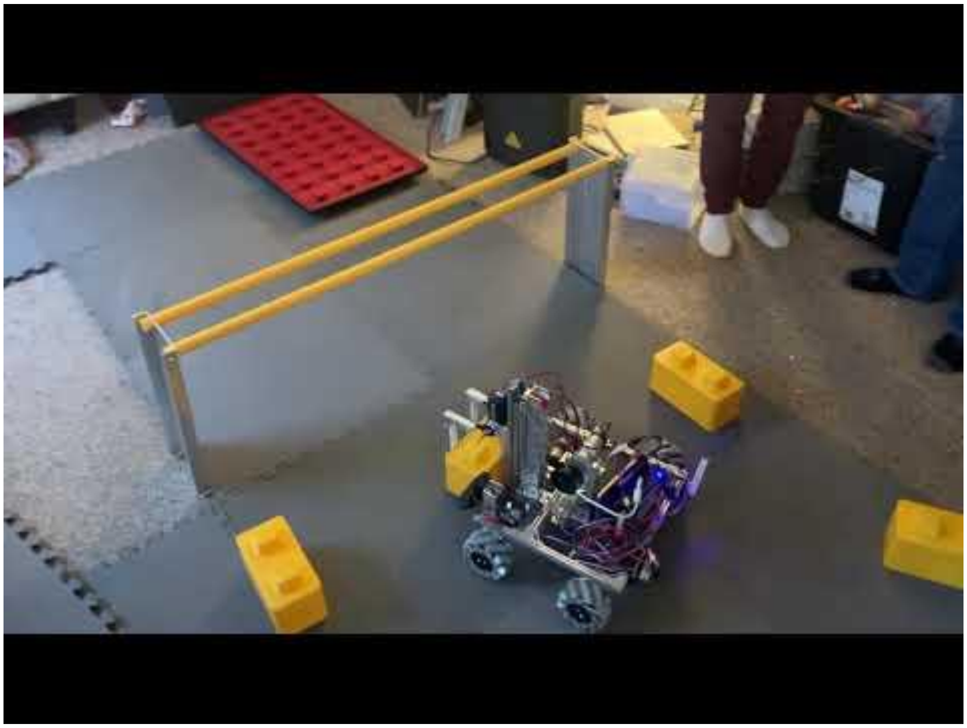
Stack with Failure

https://youtu.be/pKQjchItBaM

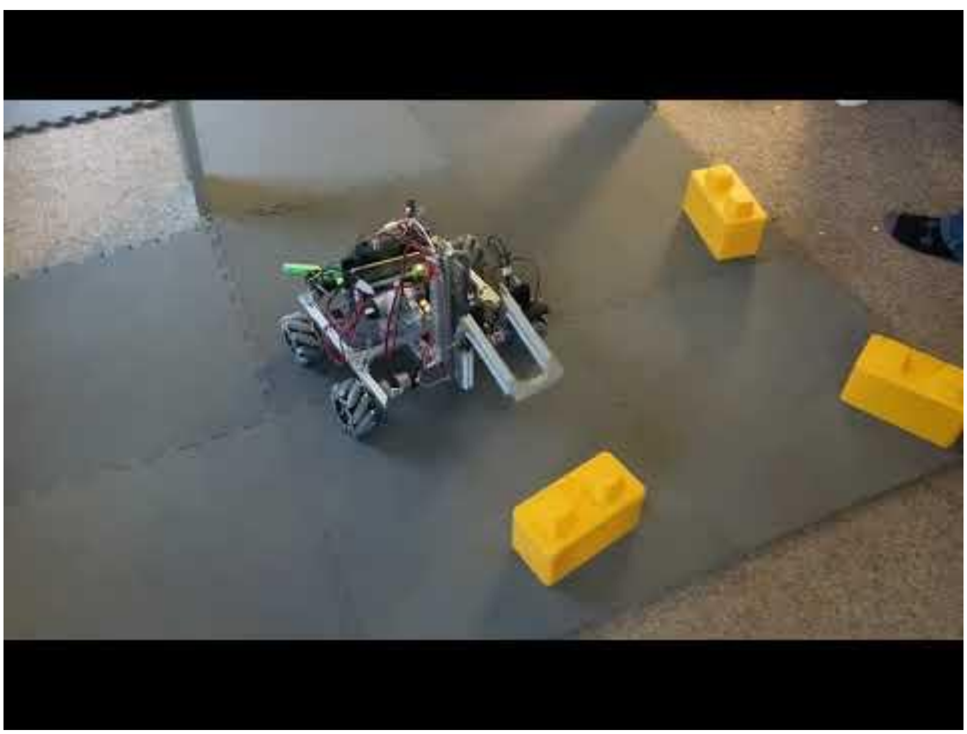
Foundation Test

https://youtu.be/O3KeIbRDpe8

TeleOp Stack with Foundation 1



TeleOp Stack with Foundation 2



Practice 17 12/27/19 Autonomous

The plan for today would be to make progress on the autonomous and to compare the flight recorder approach to the measure and check approach.

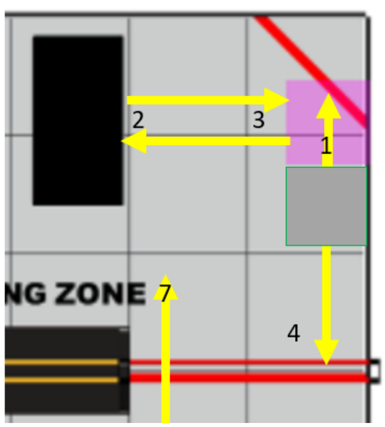
The team decided to start programming autonomous using the foundation starting position. The team choose this position because it was the most simple place to start because it did not require getting tensor flow up and running.

The team tried to use the black box and drove the robot through the autonomous section and then pulled the motor encoder data from the data file in order to use those values for the autonomous methods.

The team had to first set-up the robot floor. There was considerable debate over how to properly orient the floor to in order to make the programming easier to understand.

Ultimately, the floor was aligned like the drawing from the FTC manual so that no “mental gymnastics” were involved in converting the floor’s appearance to the diagram in the manual.

The team then spent a considerable amount of time reading about the starting position rules. The team determined that the robot could not start in a scoring position, it must be touching the wall.



Foundation Starting Position

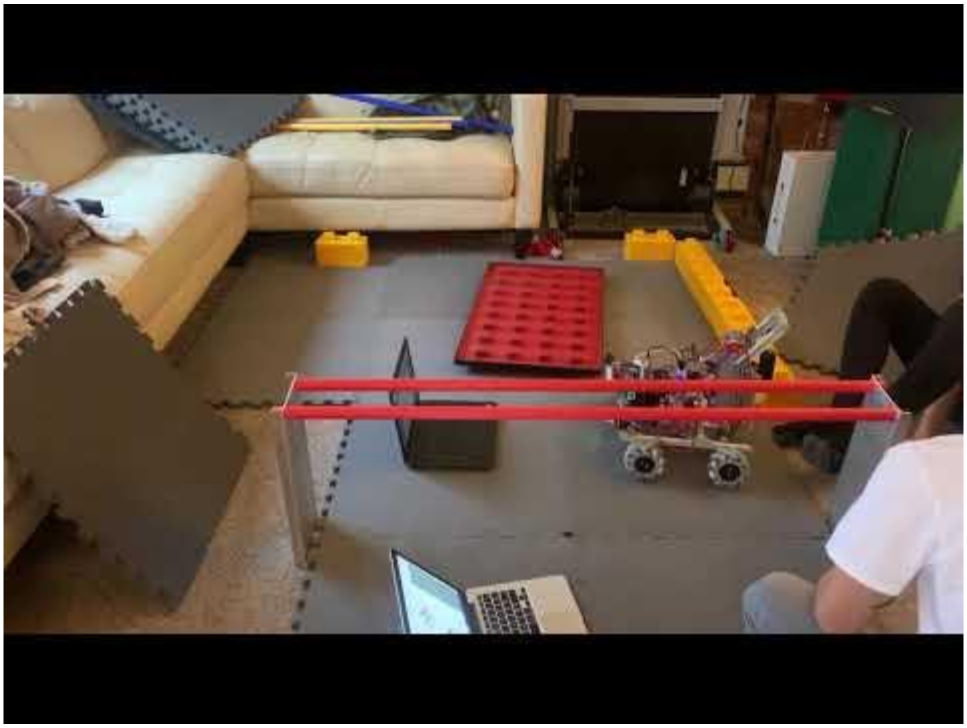
1. Strafe along wall toward center of foundation
2. Drive to foundation
3. Run servos to hold foundation
4. Pull foundation
5. Strafe to parking line

Sky Stone Starting Position

1. Advance to optimize tensor flow view

The preliminary plan is listed in the steps above.

This video shows that initial run.



Practice 18 1/05/20 Skystone Navigation

The team will most likely review the autonomous from the last practice sessions and begin working on the tensor flow.

1. Optimal distance for camera
2. Optimal angle for camera
3. Scenarios-1,2 and 3 (what are the driving conditions to reach stones)
4. Autonomous linear regression with black box on distance and rotations
5. Write demo method (test)
    a. Detect stone or move to detect stone
    b. Collect stone
    c. Deliver stone
    d. Park
    e. Verify under 30 seconds and works everytime.

The team needs to make some progress on the Cap (could just cut a stone in half)

This is a screen shot of the data file after it was imported to excel.

Trial #1 by Team #9721 on 12/21/19

	A	B	C	D	E	F	G	H
1	Trial #1 by Team #9721 on 12/21/19							
2	StrafeLeft	188.652	3	3	-2	-3	8.19	
3	StrafeLeft	188.72	32	45	-40	-33	8.19	
4	StrafeLeft	188.7881	66	80	-93	-70	8.19	
5	StrafeLeft	188.8572	118	118	-145	-120	8.19	
6	StrafeLeft	188.9658	200	200	-238	-208	8.19	
7	StrafeLeft	189.0281	249	251	-300	-263	8.19	
8	StrafeLeft	189.0981	310	311	-366	-327	8.19	
9	StrafeLeft	189.1929	392	396	-463	-418	8.19	
10	StrafeLeft	189.2523	447	452	-523	-475	8.19	
11	StrafeLeft	189.3181	507	515	-594	-541	8.19	
12	StrafeLeft	189.3864	573	582	-668	-608	8.19	
13	StrafeLeft	189.4987	678	694	-790	-719	8.19	
14	backward	189.9889	814	817	-947	-860	8.19	
15	backward	190.0999	875	724	-842	-947	8.19	
16	backward	190.1677	943	648	-769	-1023	8.19	
17	backward	190.2411	1033	554	-679	-1123	1.276	
18	backward	190.314	1130	447	-580	-1229	1.244	
19	backward	190.3839	1232	340	-479	-1336	1.231	
20	backward	190.452	1335	230	-374	-1448	1.2	
21	backward	190.5509	1490	63	-223	-1615	1.131	
22	backward	190.6528	1656	-119	-59	-1787	1.108	
23	backward	190.717	1760	-232	44	-1898	1.095	
24	backward	190.7858	1872	-353	155	-2021	1.023	
25	backward	190.8471	1974	-463	253	-2123	0.987	
26	backward	190.9162	2091	-589	373	-2249	0.981	
27	backward	190.985	2205	-713	489	-2374	0.948	
28	backward	191.0779	2363	-879	646	-2538	0.892	
29	backward	191.1767	2532	-1059	809	-2714	0.845	
30	backward	191.2457	2649	-1185	926	-2841	0.817	
31	backward	191.6248	3125	-1713	1380	-3343	0.642	
32	backward	191.7282	3230	-1826	1496	-3468	0.684	
33	backward	193.0989	3588	-2221	1839	-3840	0.638	
34	backward	193.1621	3621	-2259	1884	-3889	0.651	
35	forward	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

The team then calculated the amount the front left motor encoder changed during each of the following movements:

Strafe	675
Backward	2807
forward	-3042
strafe	-4480

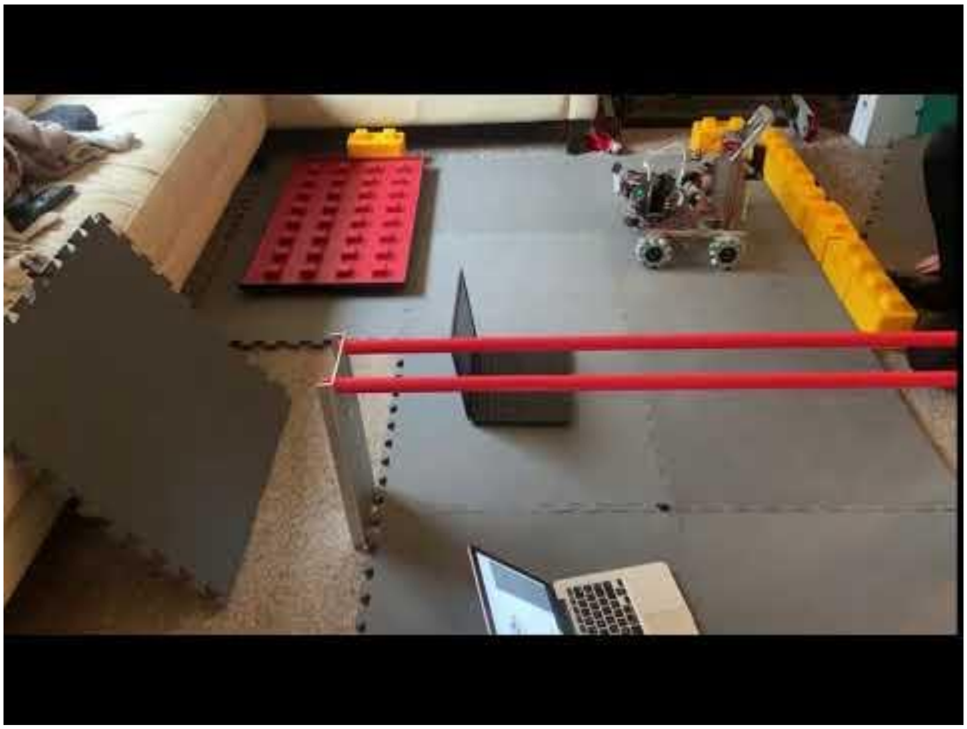
Next, the team made some methods to run the robot

```
//autonomous methods
public void backwardEncoder(int target){

    resetEncoders();

    //int finaltarget=driveFL.getTargetPosition()+target;

    while (driveFL.getCurrentPosition()<target)
    {
        mecBackward(.25);
        writeMotorData("backwardEcoder");
    }
    mecAllStop();
}

public void strafeLeftEncoder(int target){

    resetEncoders();

    //int finaltarget=driveFL.getCurrentPosition()+target;

    while (driveFL.getCurrentPosition()<target)
    {
        mecStrafeLeft(.25);
        writeMotorData("StrafeLeftEcoder");

    }
    mecAllStop();
}

public void resetEncoders () {

    driveFL.setMode(DcMotor.RunMode.STOP_AND_RESET_ENCODER);
    driveFR.setMode(DcMotor.RunMode.STOP_AND_RESET_ENCODER);
    driveBL.setMode(DcMotor.RunMode.STOP_AND_RESET_ENCODER);
    driveBR.setMode(DcMotor.RunMode.STOP_AND_RESET_ENCODER);

    driveFL.setMode(DcMotor.RunMode.RUN_WITHOUT_ENCODER);
    driveFR.setMode(DcMotor.RunMode.RUN_WITHOUT_ENCODER);
    driveBL.setMode(DcMotor.RunMode.RUN_WITHOUT_ENCODER);
    driveBR.setMode(DcMotor.RunMode.RUN_WITHOUT_ENCODER);

}
```

The team then inputted those values and tested the robot for the strafe and backward drive. Once the team had these under control, they could move onto the other domains.

During testing, the robot strafed perfectly. However, it was consistently short on the backward run. The team considered many different possibilities for the problem.

This video shows the problem…

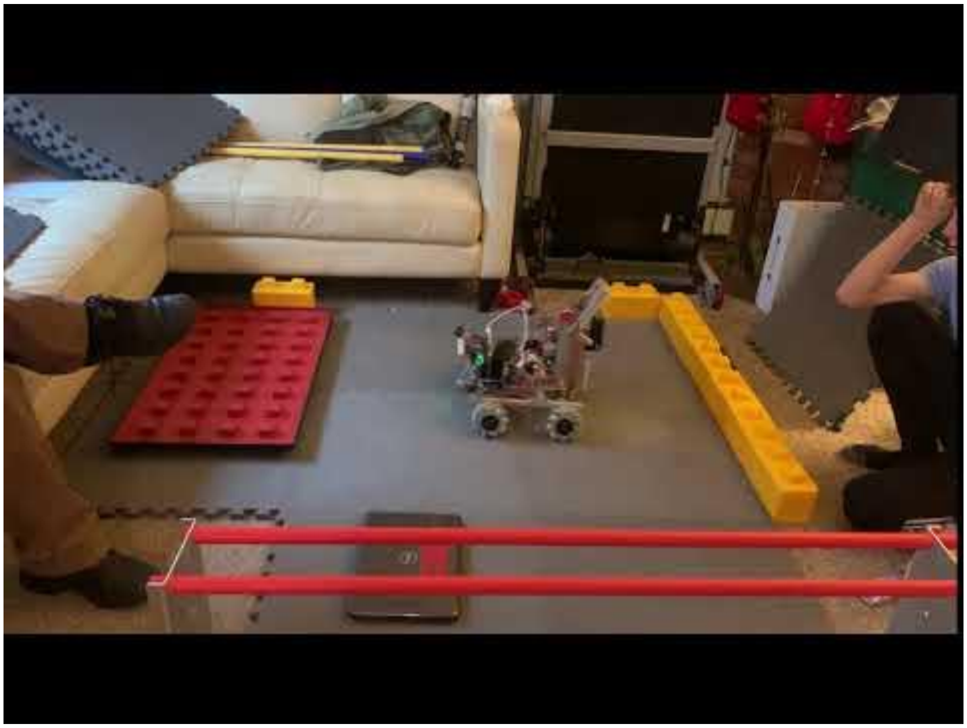


First, the verified that the motor encoders were not reporting that they had traveled the correct distance. This analysis determined that the motor encoders had not traveled the correct distance.

Second, the team determined that the speed in autonomous and the speed of the teleOp were different. They then set the speeds to be equal, which made a slight improvement to the run, but not not enough.

The team then determined that there must be an issue with the encoders. If the encoder stored the current setting and continued to add to it, the encoder values should have been reporting that it was larger each time, by the amount of the previous time. So, 2000, then 4000, and so son. However, this was not the case. The encoder values appeared similar each time. This suggested to the team that the encoders were passing a critical value and then resetting.

18 trials later, This video shows the solution…

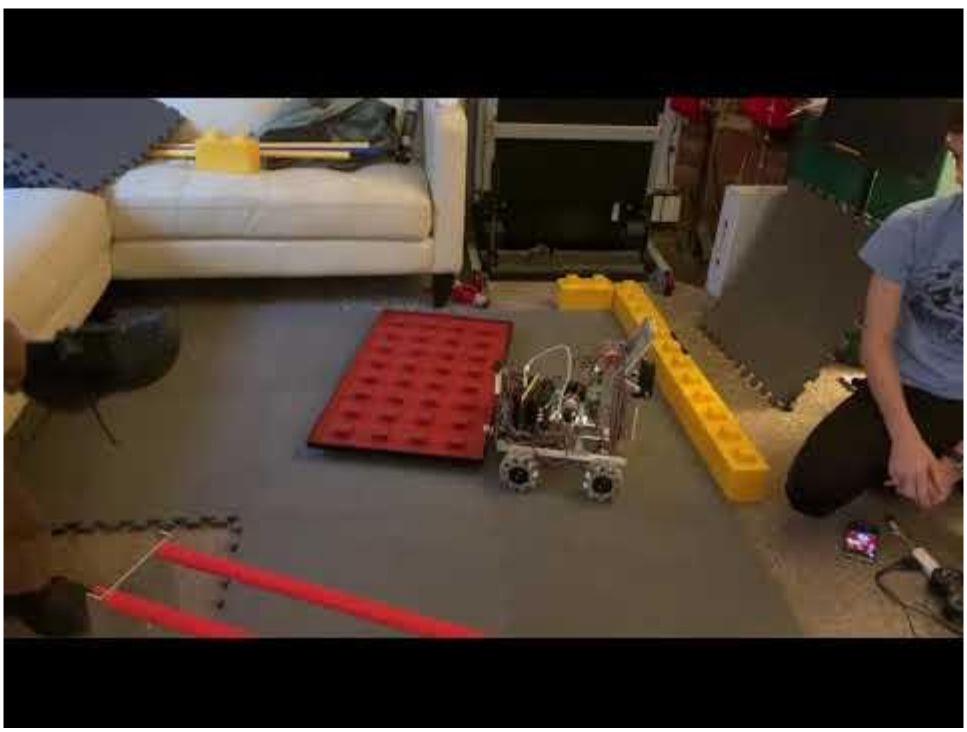


Third, the team decided to reset the encoders after teach trial run. This corrected the backward problem. However, the initial run and the current runs were slightly off so the team made some minor correction to get everything running again.

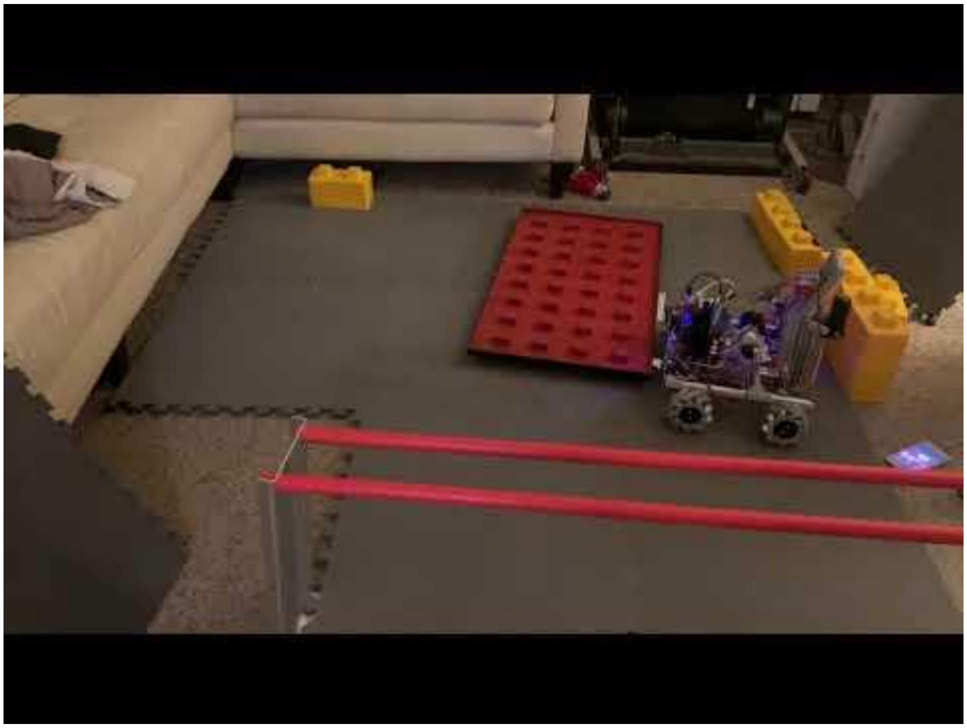
The next step was to add the servos to the opMode. This was done by placing the teleOp code into a method and then calling the method.

```
public void grabFoundation(){

    arm.setPosition(0);
    arm2.setPosition(1);
    sleep(200);
    idle();

}

public void releaseFoundation (){

    arm.setPosition(.5); //.750
    arm2.setPosition(.5); //.250
    sleep(200);
    idle();

}
```

The gripper, forward and strafe were all added and the alliance bridge was moved to allow the robot to pass under it without hitting it.



The team attempted to move the gripper motor, but decided that it was the wrong approach. They made this decision because the gripper, if moved, would probably hit the outside wall. Thus, they re-visited the rules for parking and decided that the robot would could as parked it any part of it was under the alliance bridge. Therefore, they decided to rotate the robot and swing it under the bridge. This took some fine tuning and some additional autonomous methods, but it was ultimately corrected to produce this as the result



The final run took 26 seconds. The robot might be able to do the run a little faster, but probably not fast enough to complete both the tensor flow and the foundation challenges.

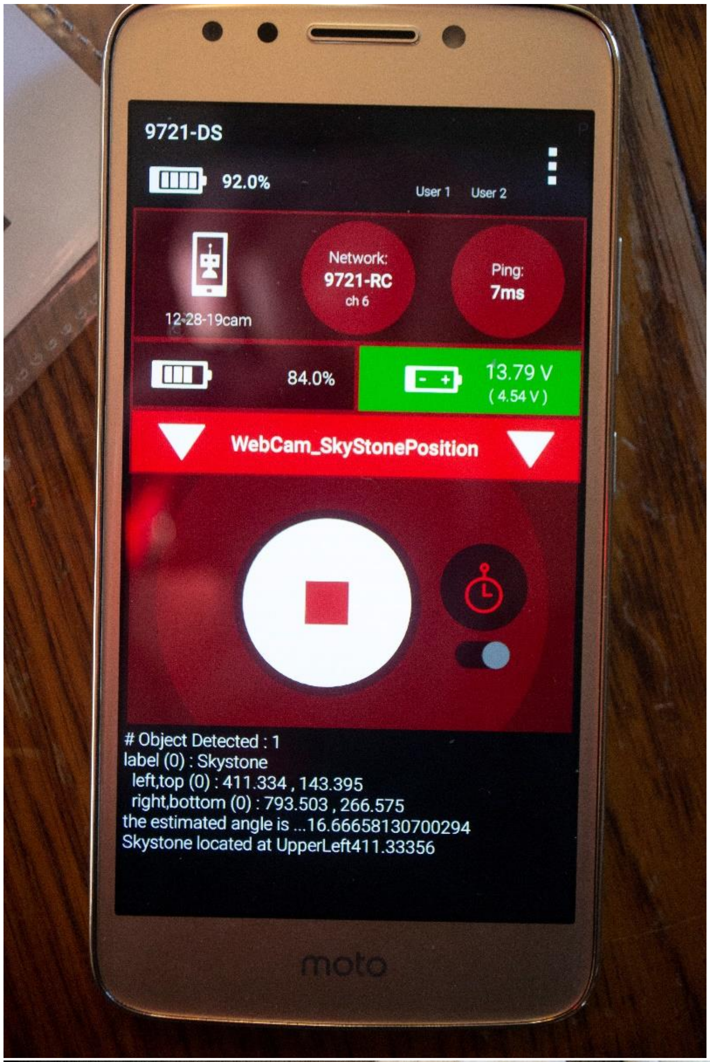
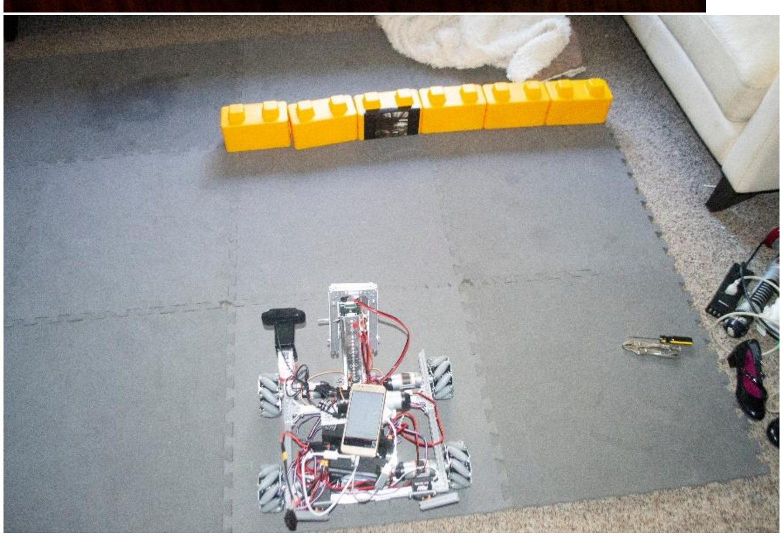
At the end of practice, the team decided that the blue version of this teleOp would be considerably easier because they had already completed most of the difficult challenges.

They also decided they might need to make some changes down the road to allow the robot to park on the outside or inside to accommodate another team that might choose to park on the inside.

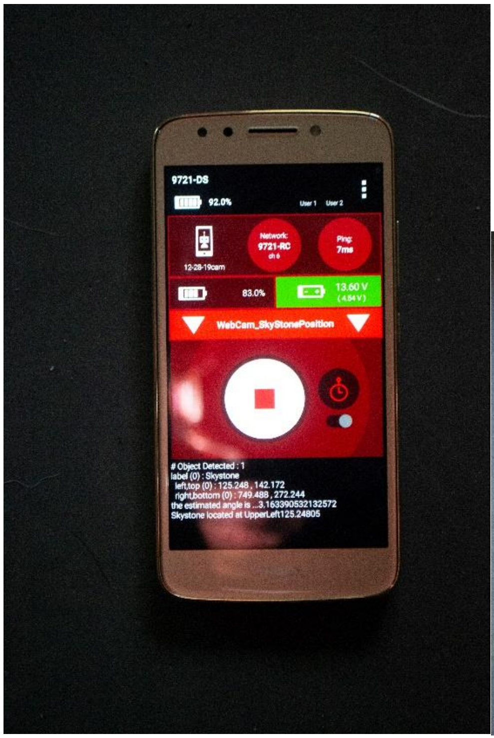
Practice 18

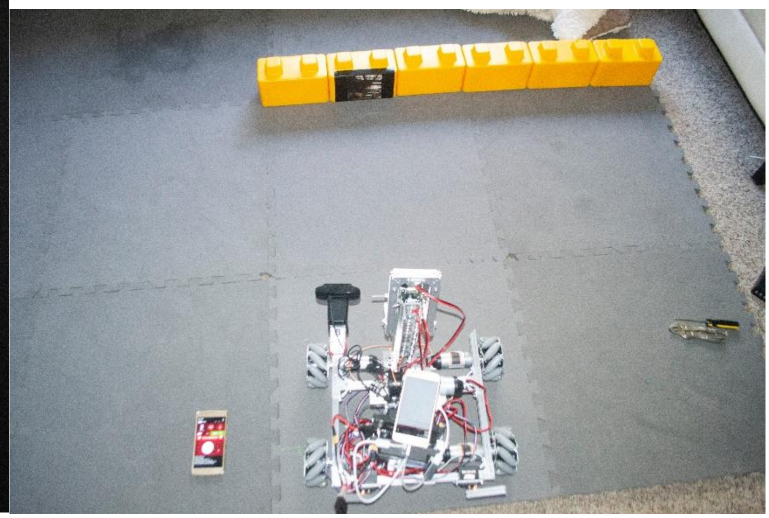
The goals for this practice will be to get the autonomous running for the red from the skystone position.

The first thing the team will need to do is to find a starting position that allows for the best access to the stones. The team will want to place the stones in all three starting positions to determine the angle on the web cam and distance from the stones to use the webcam before determining if the stone positions make a difference.


9721-DS
92.0%
User 1
User 2
Network:
9721-RC
ch 6
Ping:
7ms
12-28-19cam
84.0%
13.79 V
(4.54 V)
WebCam_SkyStonePosition
Object Detected : 1
label (0) : Skystone
left,top (0) : 411.334 , 143.395
right,bottom (0) : 793.503 , 266.575
the estimated angle is ...16.66658130700294
Skystone located at UpperLeft411.33356
moto


The robot will be placed in the middle of the last three skystone, making the movement the least





	Middle of Starting Position		
Skystone Position			
1	Left	411	143.395
	right bottom	793503	266.575
	Angle	16.66	
2	Left	125.248	142.172
	right bottom	749.498	272.244
	Angle	3.16	

The lighting in the living room was coming from behind the stones, which means that the image was very difficult to detect from a distance. That being said, the other two stones were detected relatively easily. The second stone need a slight twist of the robot to find it.

That method is relatively easy to end, which allows the robot to move onto the next part, which would be grabbing the stone and then driving across the alliance bridge before returning to park.

The team might want to put some energy into adding a timer to the method to help the robot make decisions during autonomous.

The phone needs a permanent home on the robot.

The camera needs to be fixed in place.

The lifter motor needs some bracing.

The electronics need to be securely mounted.

Current State of the Robot

Autonomous (15 pts)

Move Foundation (10 pts)

Park (5 pts)

TeleOp (12 pts)

Bring 3 stones across alliance bridge (1 pt each=3 pts)

Placing stones on foundation (1 pt each=3 pts)

Skyscraper 3 stones (2 pts for each level-6 pts)

End game (28 pts)

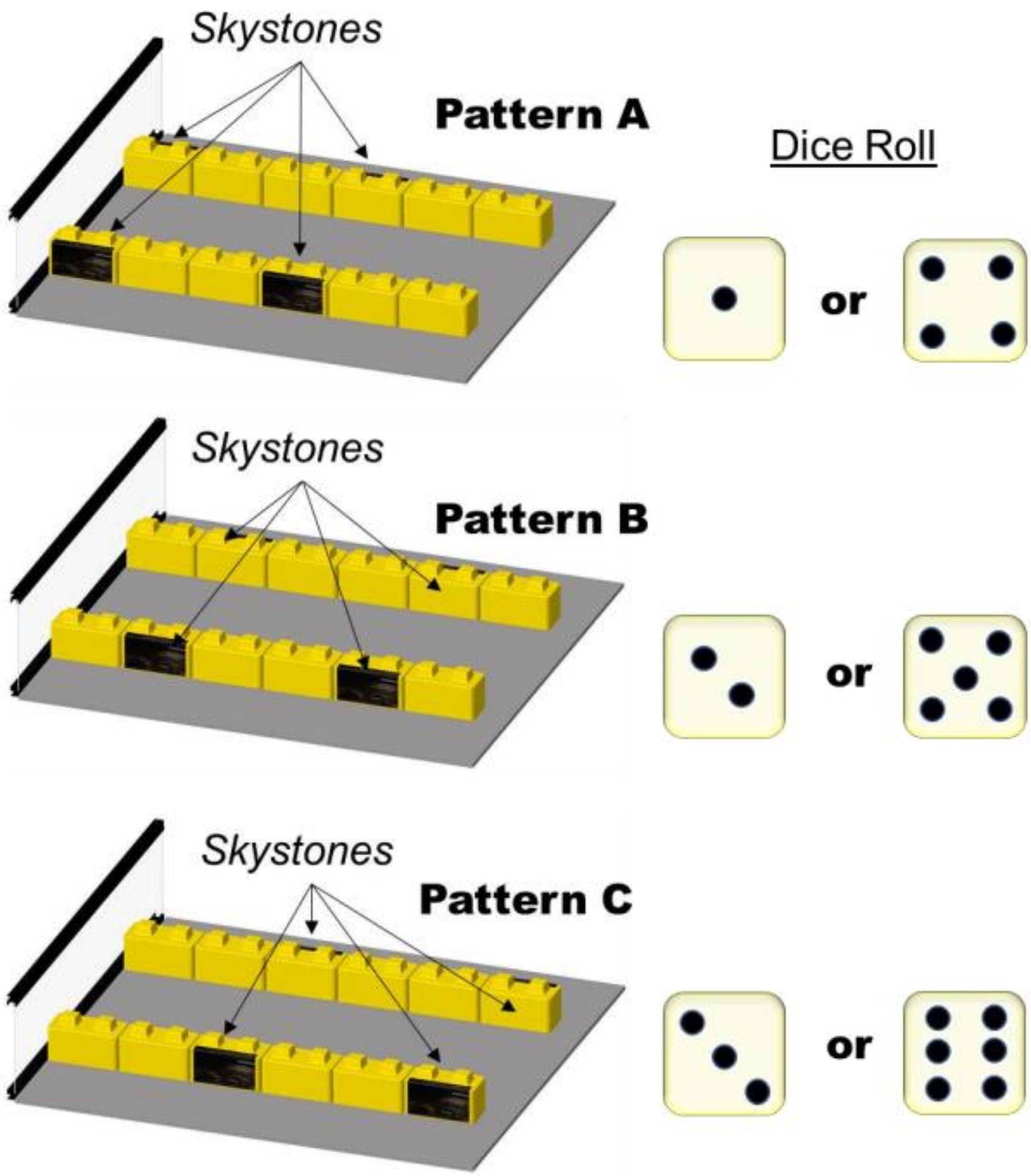
Capping (5 pts cap capping + 3 for bonus 8 pts)

Bring foundation out of building site (15 pts)

Parking (5 pts)

Total Score 55 pts

Appendix D – *Quarry* Randomization



Practice 19 1/11/20 SkyStone Vision and Foundation Correction

Everyone came to practice today but Andrew was sick so he had to go home early.

Ethan worked on the CAD drawings for the foundation attachments.

Luke and Kenny worked on the tensor flow. During last practice, the team develop dead renocking routines for the robot to follow using the black box. However, the tensor flow was not working to identify the correct stones.

It took some time to diagnose the problem with the tensor flow from the previous week. The problem was that the robot was not close enough to the stones to detect the stones easily. The team ran some experiments by moving the robot forward until it detected the skystones. The team determined that the robot needed to be abou 22 inches away from the stones in order to detect them.

Once this distance was determined, the autonomous pathways needed to be re-done. During this process, the team discovered that the previous edge values for the skystone were no longer working. This meant that the team needed to collect that information again, from the correct distance. The team also realized that they needed to measure the angle of the camera and they had to set it to a specific angle in order to keep their measurements accurate. Ethan worked on a support for the camera using foam board for the 84 degree angle of the camera.

Once the team had the tensor flow working, they easily got the autonomous working for all three positions.

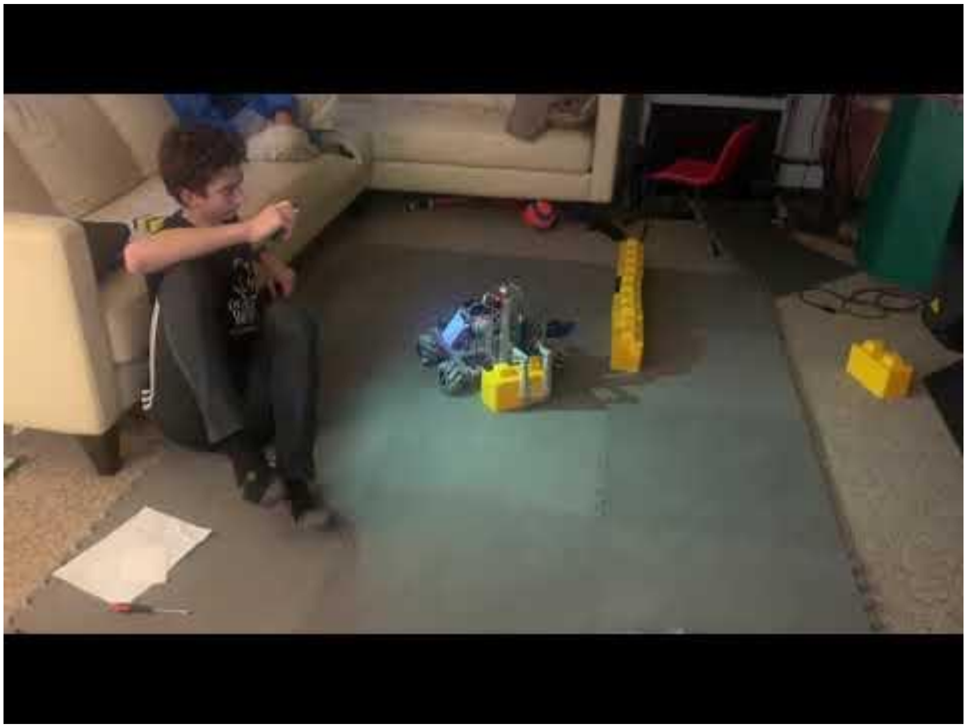
However, Luke became nervous about the placement of the stones and of small differences that might undermine the performance of the robot in competition. He advocated to place a distance sensor on the robot, so that the robot could adjust to different starting conditions.

The team placed a distance sensor on the robot and then proceeded to make some changes to the opMode to make it operate better.

After a few minutes, the team had a new opMode that worked perfectly regardless of where the stones were placed.

Middle Stone Run

The team also discovered that the lighting plays a vital role in robot vision. The robot kept missing the far stone in low lighting situations. This was remedied in testing by adding additional light.



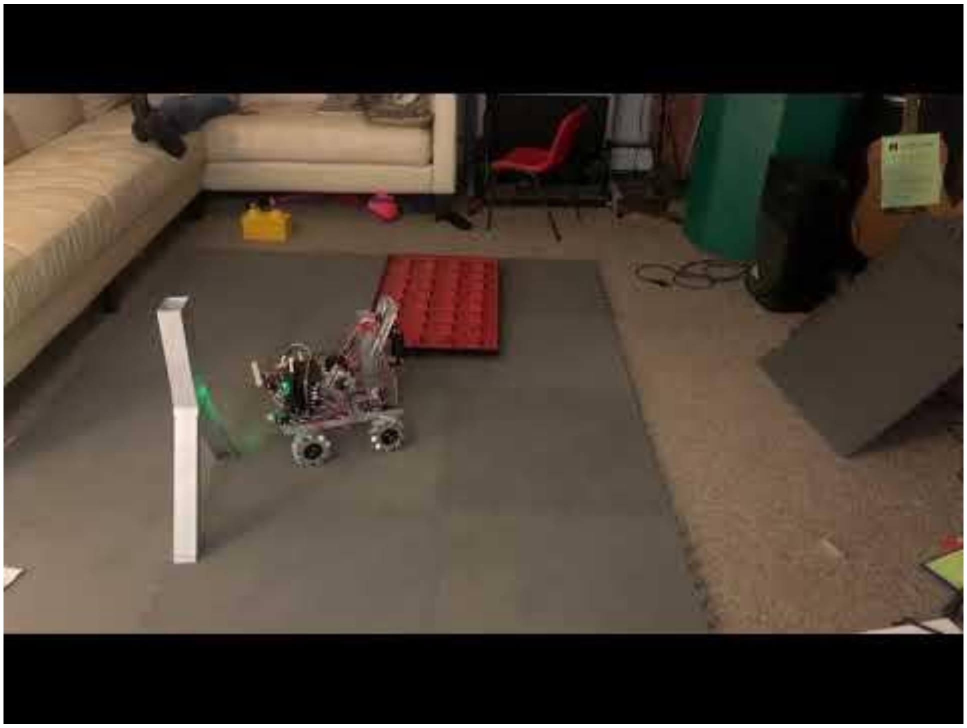
At this point, Luke also spent some time working on the foundation. The primary concern was that the robot needed to be able to park on either the inside or the outside tile, assuming another team would also want to park. Under these conditions, some changes needed to be made to the final movements.

Luke reviewing some videos and developed concern over how far the robot had to move to break the plan of the building site. Three was also concern over whether or not the robot would get stuck in the side walls of the field set-up. Luke made several adjustments to the path of the robot along the plane in order to make things work better. He also taped the field to verify that the foundation was breaking the plan of the building site.

Just when testing was also complete, Luke checked the field set-up and discovered that the posts might block the movement of the robot. To correct this, Luke placed the markers on the field and made some further adjustments to the robot. It now works perfectly for the red side.

Outside Parking

Inside Parking



Practice 20 1/20/20 Two Robot Trials

Andrew, Luke and Kenny met with the girls team to run a work-shop this morning.

The team ran through a general conversation about the pros and cons of different building systems and the team provided the girls with two robot models: last years robot and this years robot. Both models used symmetrical holonomic drive systems with an interior spine that was connected to a rev system of bumpers. Luke also presented their rejected chassis for this year. They liked it so much they decided to use it.

Luke explained how to assembly an omni-wheel castor and how to mount it onto the chassis.

Luke explained how to mount a motor and then discussed how placing the motor on the chassis will effect how the robot turns.

Luke explained the different types of wheel options so that the girls could make an informed decisions about which wheel was best for their robot. Once the wheels were mounted, the girls discovered that they had mounted the wheels too close to the frame. They thought they were going to have to take the whole thing apart but Luke showed them that they could slide the motor inside the mount in order to get it into the proper position.

Luke explained how the different size screws have pros and cons when being used for assembly.

Luke explained how his team likes to manage the electronics and the girls compared it to a flat mount and they selected the vertical mount. This girls also learned that sequencing assembly matters because the rev screws on the expansion hub could not be accessed once the tetrix channel was mounted because there was no room to place the nut driver. This included mounting a switch to the system.

Once the girls had an assembled robot, they tested it. Luke discussed with the girls how to map the actions of the robot to the gamepad. The girls made some decisions about what they wanted and then Kenny wrote a demonstration OpMode that would do those things. Kenny also renamed the girls wifi direct system so that the two robots could practice at the same time without interfering with each other.

Luke then demonstrated how to connect the battery and phone to the robot to power it up. The team discovered that there was a connection problem. They quickly checked the OTG cable because they had a similar problem recently. Then, they showed the girls how to configure the robot and test it.

Each of the girls drove the robot and pushed a block and crashed into a stack of blocks. They discovered that the program had mapped forward and backward in opposite directions.

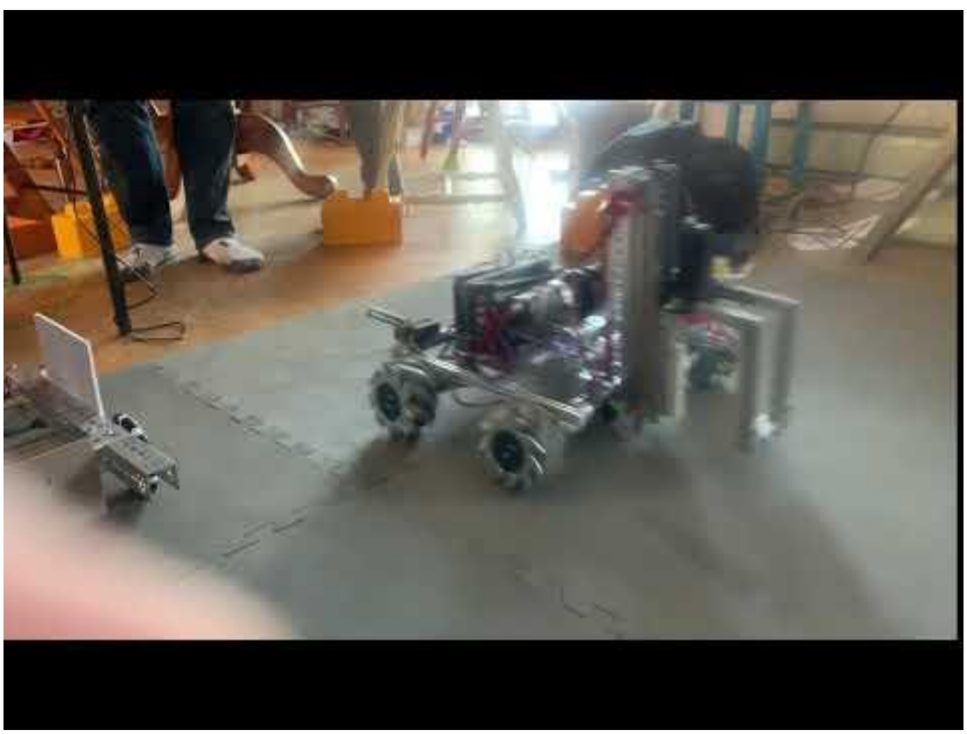
The team then made a quick sign for two sides of the robot.

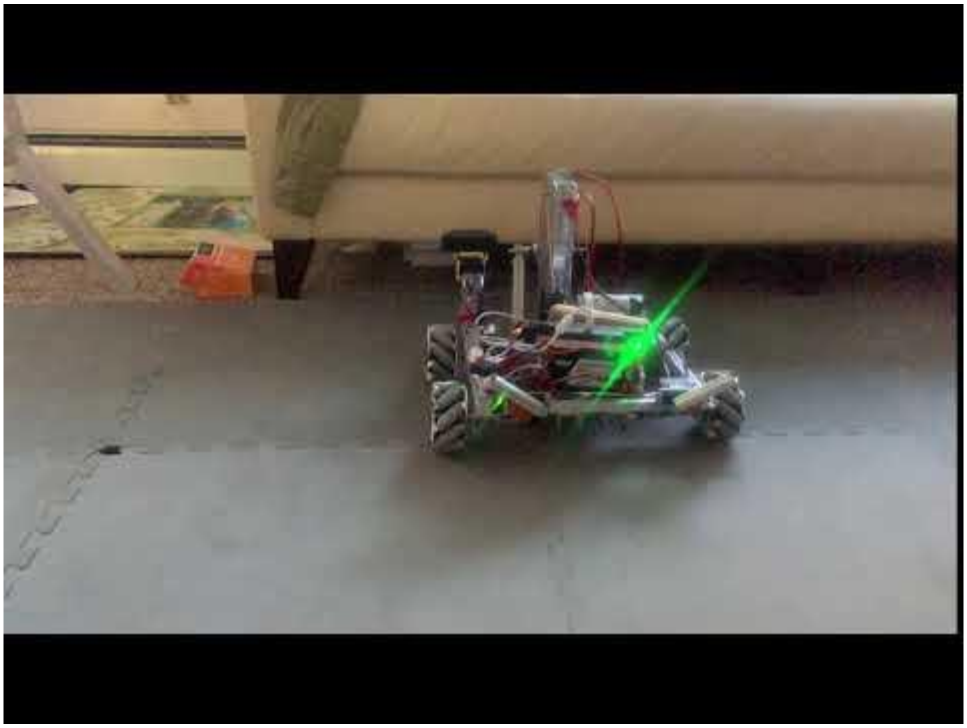
After the girls left, the boys ran some testing of both robots. During the first run, they determined that the girls robot would need some additional grabbers in the front of the robot. They also felt that they should explore a “turbo” for their own robot. They developed a pathway where the girls robot pushes blocks for the boys to assemble. The team also discovered that there might not be enough time to both cap and move the foundation and park.

The team made some modifications to the both robots. Andrew added bumpers to the girls robot. The boys robot gained a turbo booster. During these trials, they discovered that the end cap was difficult for the girls robot to move. Andrew added a cardboard bumper to make the end cap easier to push.

The team then ran several different versions of end game algorithms. They decided that moving the foundation and parking would be key so they wanted to do this, at a minimum. They also wanted to try to cap the stack but they found that it took time to get it into position and they were not sure they would have the time. They considered several alternatives such as stacking three stones instead of 4 and using the time to place the end cap.

After the team ran several more trials, Luke wanted to try to tweak the straffing of the robot. He made several slow-motion videos of the performance of the robot in order. This revealed that the drift is worse in one direction relative to the other. This was surprising to the team.





As practice wound down, the team discussed how to move forward with the engineering notebook.

Luke made several lists of the remaining tasks and assigned various people to those lists so that they could be completed in a reasonable time period.