FRC Team 5962 Documentation Binder

January 2018 - April 2018

Introduction

Welcome to Team 5962's Documentation Binder! The purpose of this document is to highlight the progress of the team from the beginning of the build season to the end of the competition season. Though with any build season, there are challenges, we are proud of the progress we have made. We have made huge strides as a team this season.

Contents

Box Manipulator

Meeting January 6, 2018

- Obtaining Blocks: 1-10
    - Sitting on the field and picking it up
        - At least 8 out of 10 tries (8 Successes is a 6) 8
        - Able to pick up the cube in any orientation 5
        - Pick up quickly 10
    - Dropped from portal
        - Can it catch it in any orientation 5
        - Secure the box so it doesn't fall out from bouncing 6
        - Control speed of catching 2
        - Can you pick it up if it does fall 7
    - Holding
        - Ability to not drop the cube 5
- Getting Blocks into Switch:
    - Can we control how it drops 3
    - Control where it drops 6
    - Get it over the fence 10
    - Ability to release at different heights (highest on top of two blocks) 7
    - Speed of depositing 6
- Getting Blocks into Scale:
    - Can we control how it drops 3
    - Control where it drops *** 3
    - Get it over the fence at lowest 4ft at highest 7ft 8
    - Speed of Depositing 6
- Getting Blocks into Exchange:
    - Can push the crate into hole over lip 8
    - Able to push it in any way 2
    - Speed

Meeting January 7, 2018

Videos for intake:
Team 118
https://www.youtube.com/watch?v=C-fA0YxxvnU
https://www.youtube.com/watch?v=I7jfwprVXMY

Robot in 3 Days:
https://youtu.be/nRJwIhfKJO0

Robot in 3 days 2018
https://www.youtube.com/watch?v=oWgz966wvNE

FRC 1156 (piston wheels?)
https://youtu.be/zcrsm2SRY3Q

Lift "Elevator" 1986 https://youtu.be/vNBUtAxtMOI

Team 1517 Robot w/ Elastic
https://www.youtube.com/watch?v=MxcBp8psQgQ

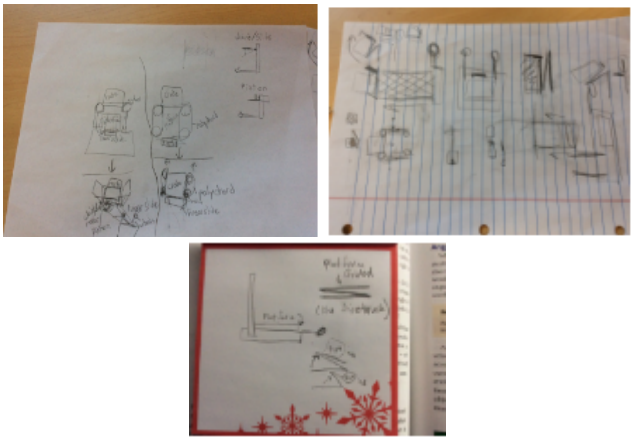
Videos for Lifting
Team 1690 Robot Lift w/ Joints
https://www.youtube.com/watch?v=XmLRMaDJGBI

Team 33 Robot Tube Release
https://www.youtube.com/watch?v=1DqZGkVHh8A

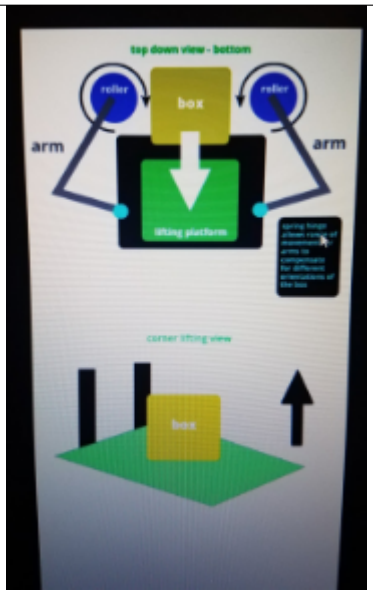
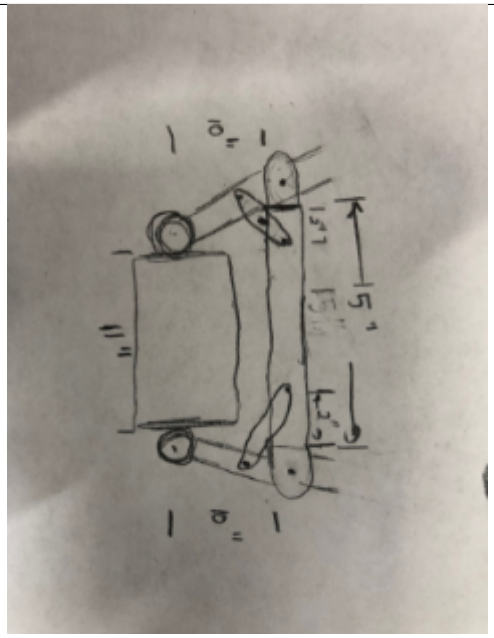
Linear Slide Tutorial]
https://www.youtube.com/watch?v=E8G0eduOfRY

Adjustable orientation
https://www.youtube.com/watch?v=0KOSkMz1hTA

Picking up and dropping for switch:
https://www.youtube.com/watch?v=xoLPN9$_jB9k$
Rough Sketches

Image/ Diagram	Description
	These are 4 ideas total. • Using wheels to pick up the cube • Uses wheels/polycord to take in the cube • A linear slide will be used to lift the cube but it carries a platform with a motor on it. The motor will move so it tilts the platform to drop the cube • The linear slide will carry the box and a piston. The piston will push the box out of the system
	This is Annie's idea of lifting the cube using a scissor lift and dropping it off by tilting the platform. Also uses wheels to pick up the box but the wheels won't move with the platform

Vector design idea (unfinished)

Image/ Diagram	Description
	A computer design of the wheel intake. There will be arms for the rollers to take in the box. A platform will lift it.
	A wheel intake using an idea from the Robot in three days. Polychord is used instead of a spring to keep the arms together. A plat will be at the bottom to make sure the arms don't go too
	(Fire truck extension idea convert to/as lift?)

Meeting January 8, 2018

Plans:

- Moruph and John: Drawing a design for a piston on the linear slide
- Aum: Redesign his idea on paper
- Yash and Katya: Work on a intake of box
- Brad: Helps CAD certain design

Accomplishments:

- Moruph and John created a mini prototype of their arm design.
- Aum and Brad worked together to start their CAD design of Aum's design
- Yash and Katya finished a diagram of the intake. A start of the prototype was with cardboard.
- David: Worked on improving his concept for a design.

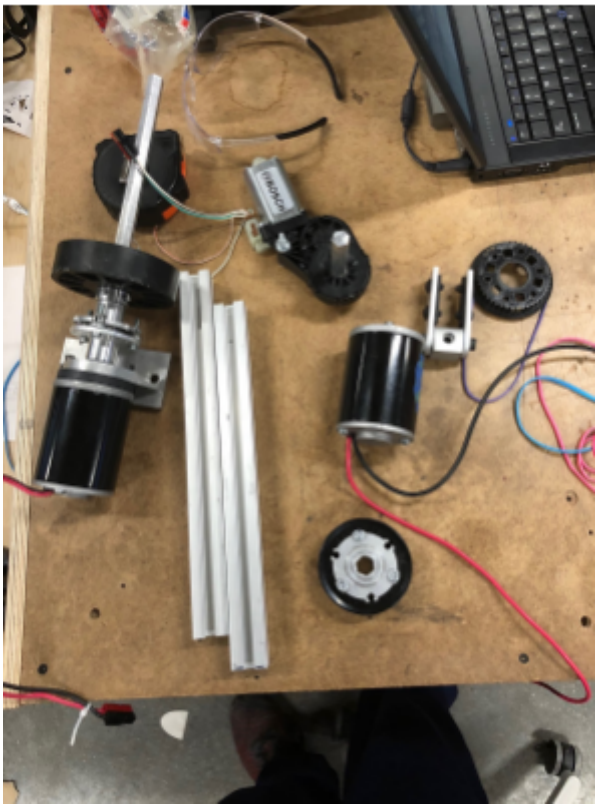
Meeting January 9, 2018

Plans:

- Yash will continue to prototype the wheel and polychord design
- Aum will try to do CAD for his design
- John will finish his prototype
- Kevin, Khushil will catch up on rules

Accomplishments:

- Khushil,Kevin-Watched videos to get ideas on what to design for the robot
- John- worked on arme prototypes and thinking ideas for material for manipulator
- Yash: Worked on approving the manipulator and started prototyping



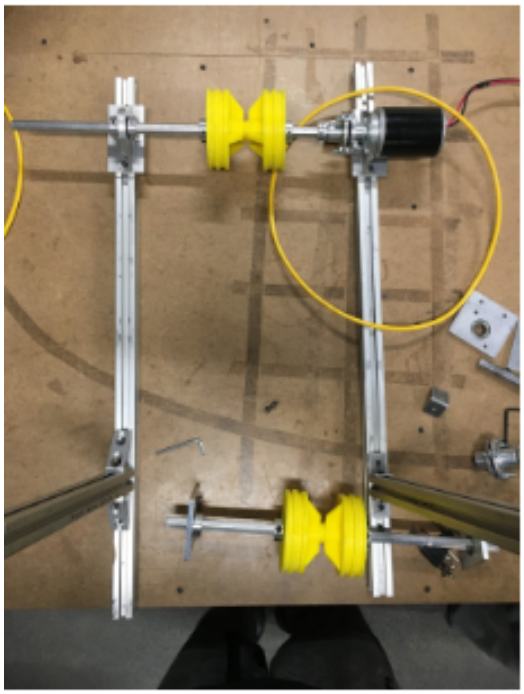
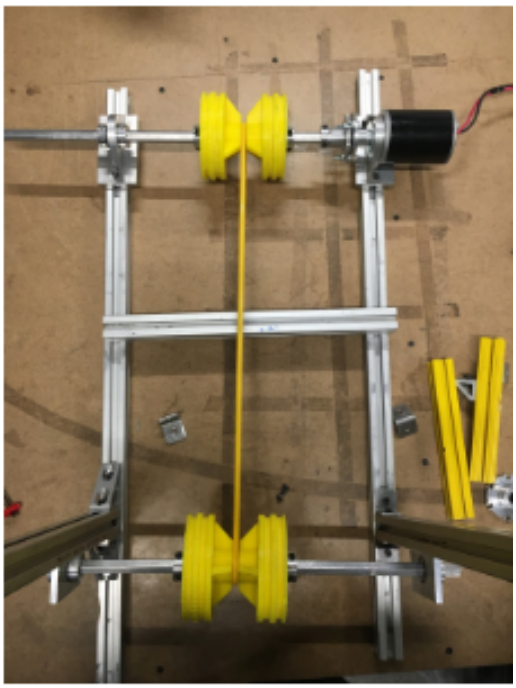
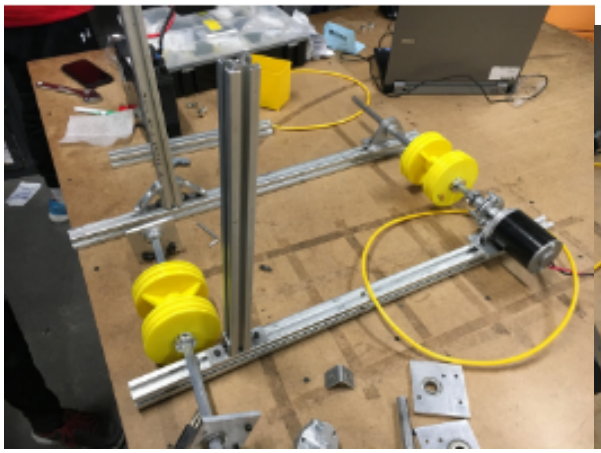
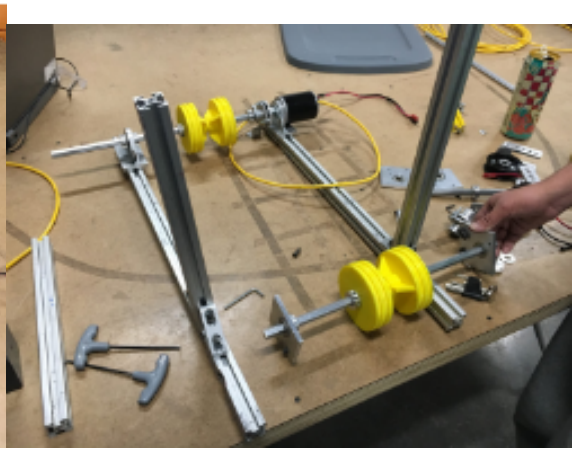
Meeting January 10, 2018

- We started making the prototype for the lift
- We gathered all materials necessary
- We should be finished the prototype by tomorrow

Meeting January 11, 2018

Accomplishments:

- Yash and Shiv completed a prototype for a wheel intake. It is not as successful as it should be because it isn't the complete design. A part needs to be ordered for the completion of the design. Here are videos for our testing of the prototype

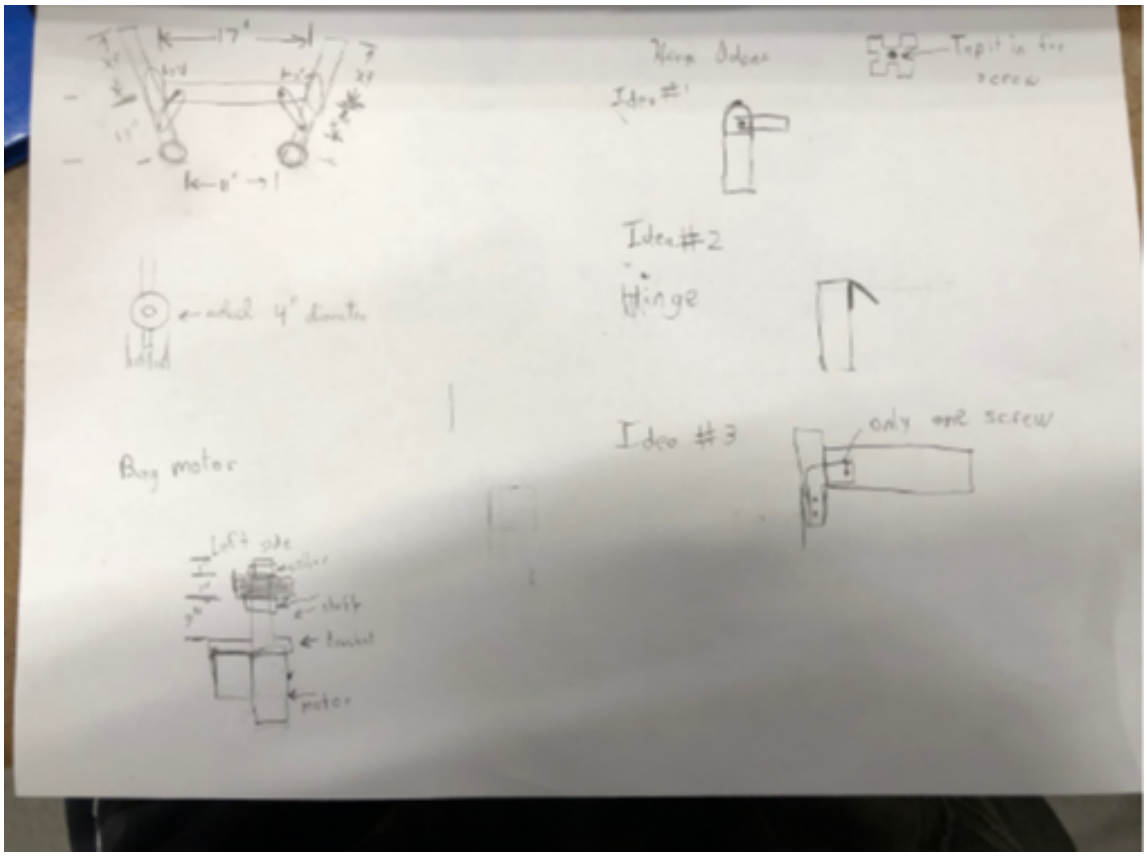
We were able to assemble our parts and finished building the base of our pulley system. It will work like a winch, the rotation of the motor will pull the line and also pull the intake system, which will be holding the cube. In this sense, we can move the cube fully up and down.

Meeting January 12, 2018

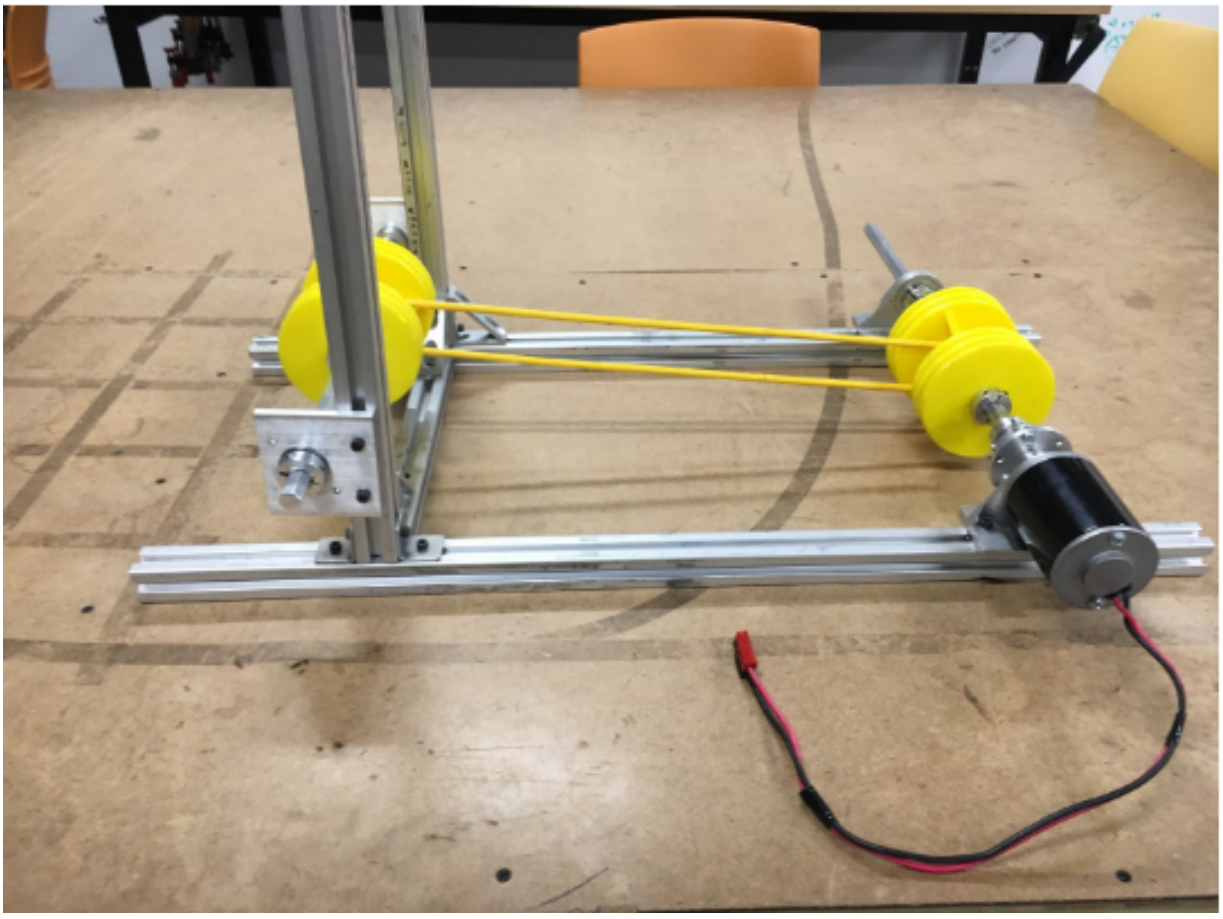
- Aum's Group will have to even out the lift out the prototype
- Yash's Group will create a list of parts that will be used for the prototype

Accomplishments:

- Yash continued to work on the wheel intake design. Also he started a list of materials page for his design to create a specific design ready for CAD.
- Here is the link to the material's page: https://drive.google.com/open?id=1r9NC$_j3aNOXUnaPvA2IzsMyKMqfAPJjQZI-BItggw7U$

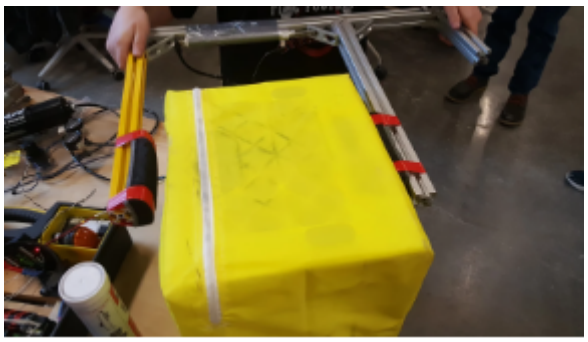


Our plan for the next meeting is to Emily will bring the string and we would move the back part of the pulley system so we have further for the pulley and add two bars to aluminum and attach the pulley to it.



Meeting January 14, 2018

Pneumatic Prototype Analysis



When prototyping we found that our pneumatic arm was not a versatile as we thought. It does not let us pick up our game cube on its side (above), or pick it up when the cube is sideways. The shortest edge of the cube is 10 $\frac{3}{4}$ ", and 18" at its longest edge; which means we need a pneumatic piston with a 7 $\frac{1}{4}$ inch throw. We also need a grippy material that can substitute for the dry erase markers we borrowed from the university

	Link	Cost	Quantity	Total
70" of 8020	https://8020.net/shop/1010-s.html	18.05	1	18.05
2 T brackets	https://tinyurl.com/y8xmjyfm	0.79	2	1.58
4 Brackets	https://8020.net/4136.html	5.65	4	22.60
Nuts	https://8020.net/shop/3382.html	0.21	30	6.30
Screws	https://8020.net/shop/3056.html	0.25	30	7.50
Grippy Material	http://www.andymark.com/green-grippy-tread-10-foot-roll-p/am-2611.htm	45.00	1	45.00
On board Compressor	http://www.andymark.com/product-p/am-2005.htm	69.00	1	69.00
Pneumatic Control Module	http://www.andymark.com/product-p/am-2858.htm	90.00	1	90.00
Pneumatic Piston	http://www.andymark.com/pneumatic-cylinder-p/am-3305.htm	54.00	1	54.00
Linear Actuator	https://tinyurl.com/ydfw5aln	31.00	1	31.00

Questionable-

Pneumatic Piston - Cost 314.03

Pros	***Cons***
Faster than linear actuator	More expensive than linear actuator
	Cannot put cubes in exchange

Linear actuator - Cost 132

Pros	***Cons***
Cheaper than Pneumatics	Slower than pneumatics
Can put cubes in exchange	

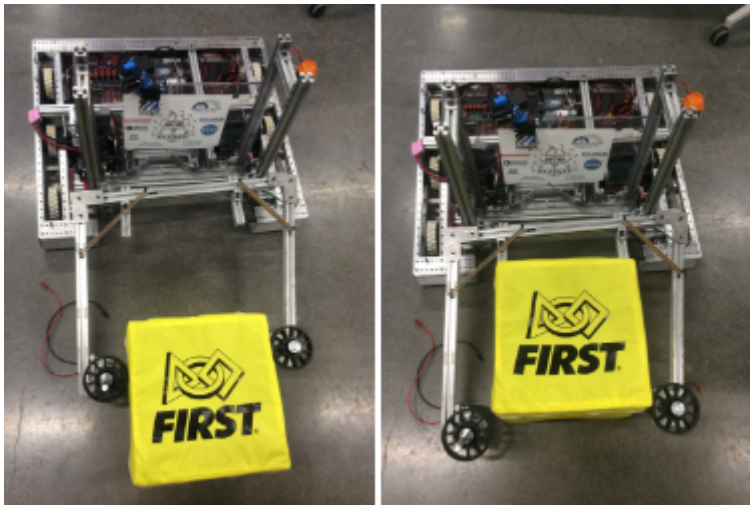
Wheel Intake Prototype

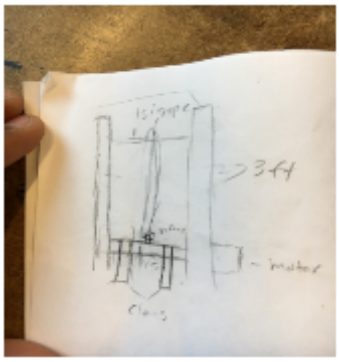
The prototype build is complete. It was mounted onto Stinger for testing. Problems that occurred were

- Mounting the motor ← can be fixed with new motor
- Brackets were too large ← ordering a bracket from 80/20 for the 10 series 80/20

- Mounting the manipulator onto the bot created stress on certain screws ← a need for review for mounting
- Needed the bar to be raised so motor isn't scraping onto the floor ← an issue that should be solved using CAD

Video for pulley system https://drive.google.com/open?id=1t1PBRRF5w420nujvUTb2Fufje3x$_{kKz}$





	Link	Cost	Quantity	Total
Linear slide	http://www.revrobotics.com/rev-25-1238/	260.00	1	260.00
80/20	https://8020.net/1010-black-fb.html	0.48 per inch	20 inches	9.60
Steel Cable	https://tinyurl.com/yay98a2f	6.65	1	6.65

We built and test the pulley system. We made some major changes and progress in the pulley system and it works.we made a list of items we need for the pulley system.

NOTES FROM DESIGN REVIEW

- Do calculations on the piston force needed

  Measure the force needed to hold the box securely, and then figure out what size piston you need

- Should we continue designing both this week?
- Can it work in auto

Meeting January 15, 2018

- Fix pneumatic manipulator stability issues.
- Connect our pneumatic manipulator to raise manipulator.
- Connect our pneumatic manipulator to the old robot.
- Min grip 10 inch Max grip 173/4 inch

Miscellaneous

Built motor controller, but the connection on linear taper is loose. The motor controller was programmed but not tested. Will be tested later.

Brad and Aum started Cad for their pulley system. We are halfway done we will probably finished tomorrow

Meeting January 16, 2018

The REV robotics lift sold out, so we spent half the meeting today looking for a replacement, not much luck. Documentation of the search can be found here :
https://docs.google.com/document/d/1fDqW6XWET-HP6NbOJmqsPfd0bn64f9eCHW8Fba4vXKY/edit?usp=sharing

- Brad and Aum continued CADing
- Josiah and Aum and David worked on the motor pickup
- Work was done on the grabber CAD

Because we are unable to do a lift at this point, we had a strategy discussion. Should we continue trying to put blocks on the scale at all?

Pros and Cons of Continuing to Go for the Scale

Pros	Cons
• Scoring advantage because the Scale is anyone's game • Better integration with the hook for the climb • Make us stand out more in later competitions	• Weighs more to go up • Expensive • Less consistency (we will be able to master the switch if we focus solely on it) • Not much experience building custom lift, waste time and resources

Pros and Cons of Not Going For the Scale

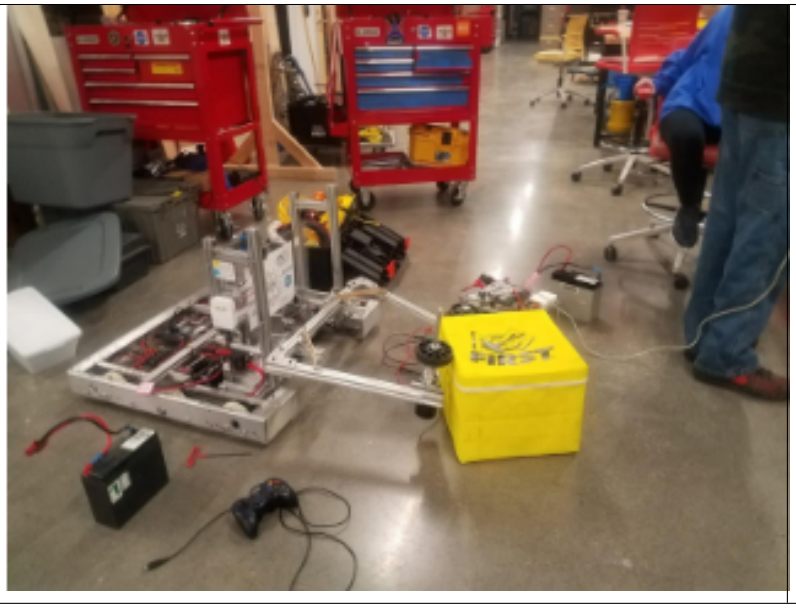
Pros	Cons
• Can focus time and energy into climber and switch • We can act as a defensive bot too and keep our opponents from scoring points by dominating both switches • We can spend more time getting power ups, which can act as if we are controlling the scale • RP come from switch and climb not scale • We can revisit the scale later on in the competition/build season	• We won't be as versatile • Need to find a new way to deploy the hook

Meeting January 18, 2018

Goals:

- Test/redesign manipulator order parts

Work:



We tried testing with the rubber bands, but it was unsuccessful. Initially we thought this was because of the weight being placed at the end. So, we moved it back and tried to use tension bands. Those were also unsuccessful because they were not properly assembled and crooked. We need a better testing setup

Meeting January 19, 2018

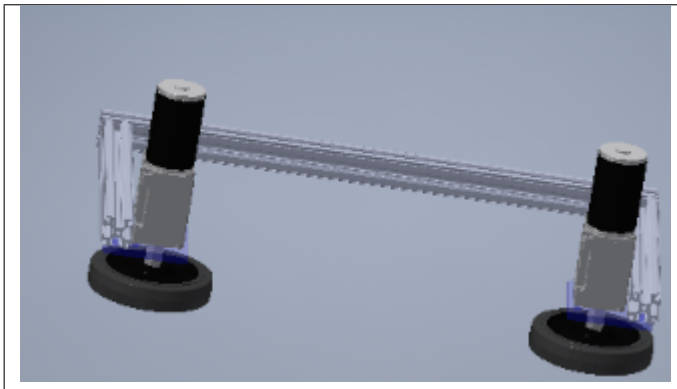
- Redesign the manipulator
- order parts
- CAD

Results

- Ordered new parts
- CADed basic redesign

Plans for Sunday

- Build stationary intake with 2 bag motor gearbox assemblies
- Try to make springs work



Basic Design for the box manipulator. We have decided to fix the position of the motors for now. Testing will continue on Monday and Tuesday.

Intake Gearing Design Calculations

Motor Specs

Spec Voltage (V)	Free Speed (RPM)	Stall Torque (N*m)	Stall Current (Amp)	Free Current (Amp)
12	13180	0.4	53	1.8

Mechanism Gearing

Driving Gear	Driven Gear	Reduction
1	36	0.028
1	1	1.000
1	1	1.000
1	1	1.000

Overall Gear Reduction	
0.0278	36.0 : 1

Mechanism Physical Characteristics

Applied Motor Voltage (V)	Load Torque Lever Arm (in) [Roller Diameter]	Gearbox Efficiency	# of Intake Sides (1 or 2)	Intake Length (in)
12	4	80%	2	20

Mechanism Outputs Under Specific Load:

Applied Load (lb)	Max Loaded Current Draw (amp)	Loaded Intake Speed (degrees/sec)	Time to travel Intake Length when under load (sec)	Loaded Intake Velocity (in/sec)	Loaded Intake Velocity (ft/sec)
10	17.87	1334.86	0.21	93.14	7.76

Mechanism General Performance Outputs:

Stall Load (lb)	Unloaded Intake Speed (degrees/sec)	Time to travel Intake Length when unloaded (sec)	Unloaded Intake Velocity (in/sec)	Unloaded Intake Velocity (ft/sec)
25.49	2198.67	0.13	153.36	12.78

We ordered planetary gearboxes to gear our BAG motors down to 36:1. It is still pretty fast, but will give us the torque necessary to get the box in our intake.

Meeting January 21, 2018

- We focused our efforts on things other than the gear manipulators today. We will continue tomorrow.
- Plan: Tomorrow we need to find a solution to this problem, in reality it should be just two Motors and though we are waiting on gearboxes, we can prototype with two drills if we have to. Even for the sake of getting just the placement of the wheels, we need to do this tomorrow and have a group discussion on how to continue.
- We did buy some parts for a slide if we chose to continue with that later on.

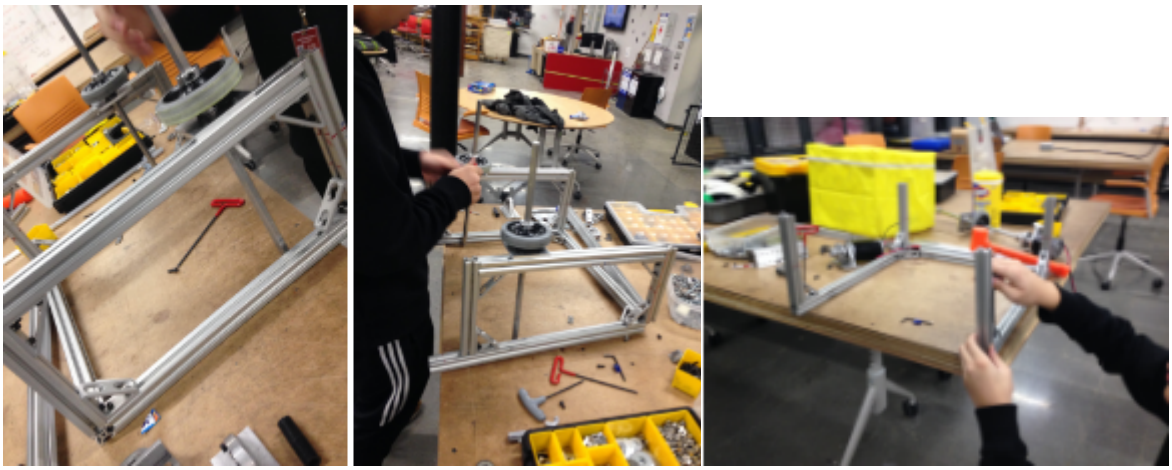
Meeting January 22, 2018

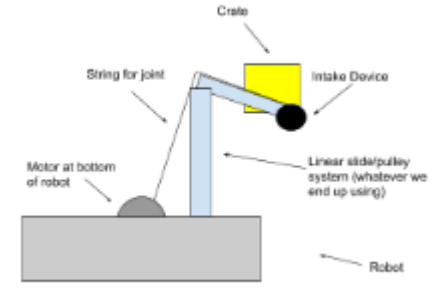
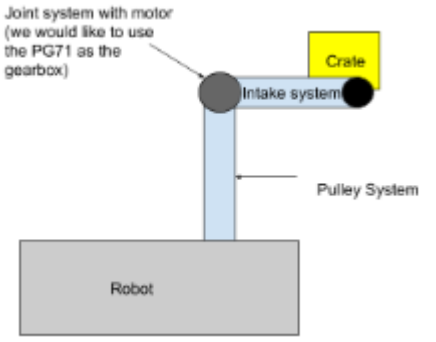
We built a prototype of the block intake with two motors and wheels. It can only take cubes in the standard from. It will be finished by 1/23/18

Meeting January 23, 2018

Today we continued and improved the original design for the box manipulator. We improved the structural stability of the frame, and optimized the motor mounts. We had a problem with the motors, so we had to find new motors. The new motors had problems with mounting, keys, and wire connection. Overall we made decent progress, we did not reach the goal of mounting and testing, but we will finish the manipulator at the beginning of the meeting tomorrow.

Working on our box intake out of 8020.



	Joint System diagram 1:
	Joint System diagram 2: (We will most likely use this one)

Meeting January 24, 2018

- Started CADing box manipulator
- Started work on prototype, we are using the linear slide. E assembled the base frame we now have to start working on the intake itself.

Meeting January 25, 2018

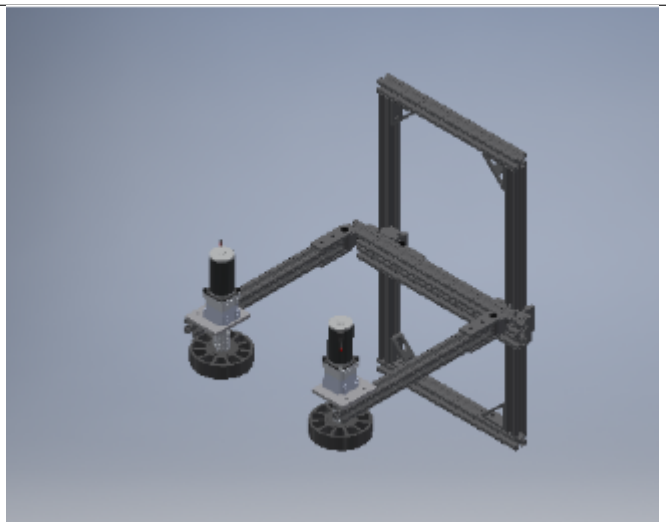
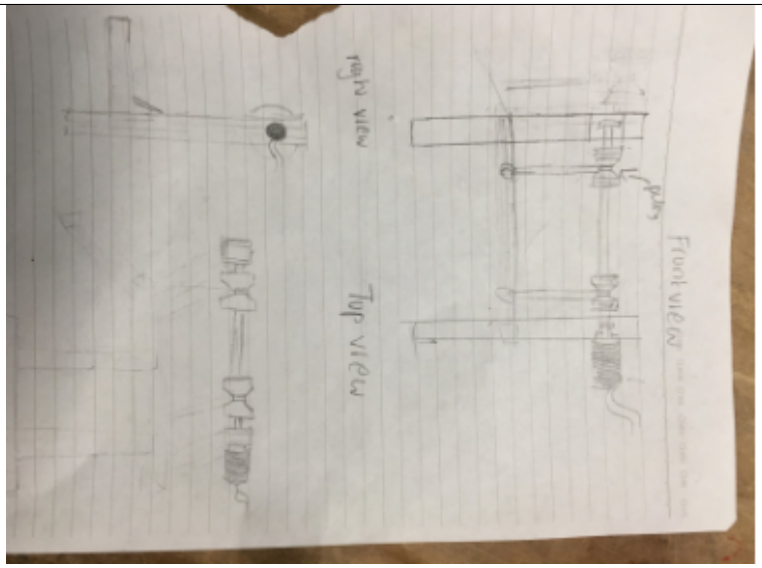
- Continued CADing box manipulator
- Worked on prototype we finished the prototype in cad now we have to build it.
- Worked on and idea that would use hinges to make it go up and down to abide by the starting configuration rules

Meeting January 26, 2018

- We emailed mike to order a part for it to go inside the starting configuration
- We are making all the parts to build it

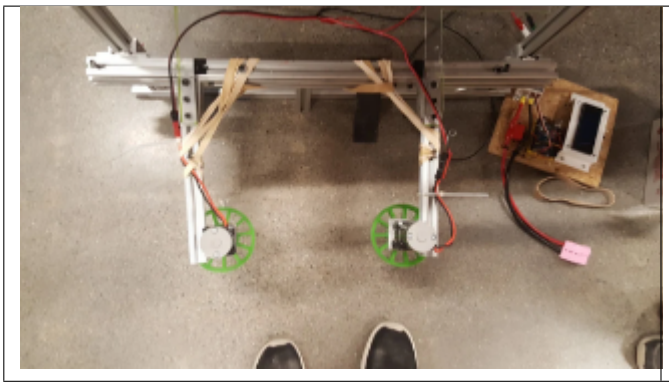
- We will son add the cad model to the robot

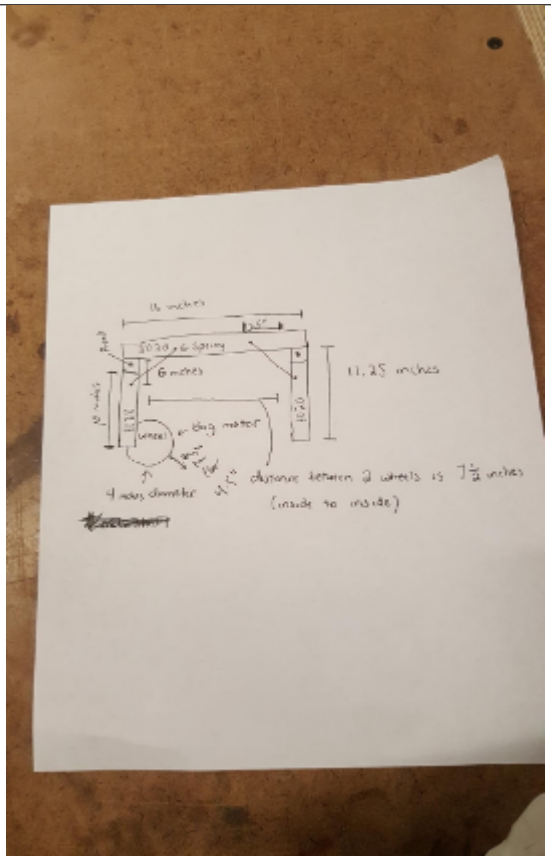
Meeting January 28, 2018

	
	We sketched and improved on the design of the linear slide

Meeting January 29, 2018

Electrical-started exact measurements and layout of electrical board and began CADing it. So we decided upon the reo and power distributor panel location. The router and voltage switch are still tbd on there location which will be in an accessible location and not the electrical board.(sorry there are no pics :()

	Top View We will replace the rubber bands with springs When brackets arrive we will add them so when can make it go up and down to start inside the bot the extend out.



This is a detailed sketch on the prototype and it has all of the measurements and the materials we used. The pictures of it and the video of testing will all be below. Jeff caded the manipulator. Shivam drew a large scale robot to see how everything fits. David P. worked on the linear slide with tom and aum. We are waiting for the bracket the will rotate it so it starts inside the robot and expands out. We NEED to get the right size springs with the right force.

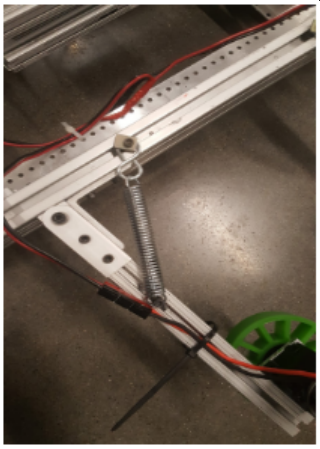
The testing is in this videos below if they ever load Here are the links:
https://drive.google.com/file/d/1FLYAj-YT7BbpRs8ChMSwIlwsMXZBe708/view
https://drive.google.com/file/d/1L822uWhpJffJaBZMPK-SeBFmsp1yiRLb/view https://drive.google.com/file/d/115jZBB90ioVKLqzdy
In the videos we tested it to put it into the exchange, to pick it up and simulate the chances of it getting loose and falling out of the intake.
The process is, First kick the cube into the the intake(simulate how we would drive into it) the speed is 11 on the motor controller Next pick it up with the linear slide and shake it(simulating driving it and being bumped into) Line it up with the exchange and score

It worked 5 out of 5 times. Now we have to attach the slide and possibly put attach it the robot The Cad file needs to be updated when we get the springs that we want I think Dave S. will be getting a variety of springs to tests

Meeting January 30, 2018

Today was a very productive meeting we accomplished:

- Attach the intake to the chassis
- Tested to see problems and solutions
- Finished the linear slide



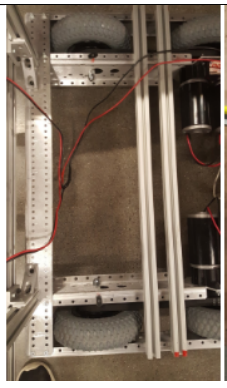
David Polgreen bought spring and we used them for the intake!!! Thank you!!! Below is the spring in use and the picture of the package. It has a force of 4.75 pounds per inch
Testing:

- We can intake the cube and it grips it well.
- It can grip it even when we get hit by a robot
- We are consistent on intaking the cube, 85
- Watch the vids for more info!!

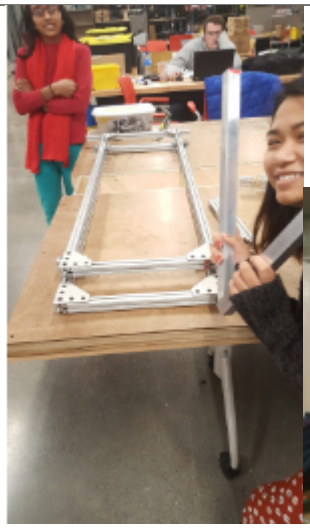
Now with the linear slide we finished it pictures below It height is 48 inches in it not expanded form Its height when extending fully up is exactly 7 feet

Meeting January 31, 2018

Even though not a lot of people showed up we accomplished a fair amount with the few that did: Fixed linear slide
Cut box aluminum for intake
Started mounting points to mount linear slide on bot



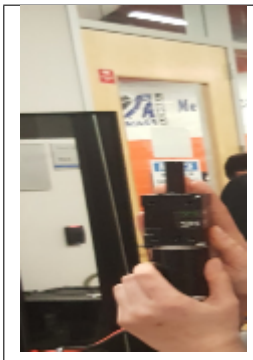
We will mount it onto the forth holes on the chassis. The mount will be the bar on the picture on the right




How the linear slide looks like
Its has 13 inch cross bars

Meeting February 1, 2018

- Goals continue work on slide
- Do motor calculations for slide
- Mount Pivots
- Electrical board has all parts intact, and has measurements for exact locations on board



Motor Calculations for Lift
We don't have the parts we need to use more planetary gearboxes. Perhaps we could find another solution or purchase more parts.
The team is leaning toward buying more parts.We made the gearbox for the rev robotics slide. Its gear ratio is 21:1

Driving Gear	Driven Gear	Reduction
1	21	0.048
1	1	1.000
1	1	1.000
1	1	1.000

Overall Gear Reduction	
0.0476	21.0 : 1

Mechanism Physical Characteristics:

Applied Motor Voltage (V)	Load Torque Lever Arm (in) [Pulley Radius]	Gearbox Efficiency	Travel Distance (in)
12	0.5	80%	7

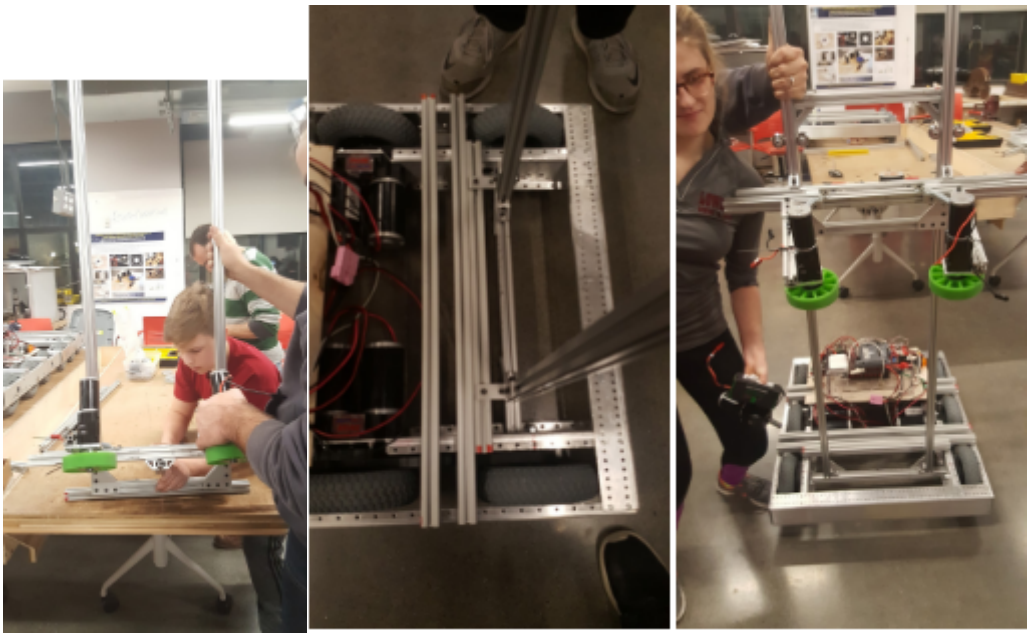
Mechanism Outputs Under Loading:

Applied Load (lb)	Max Loaded Current Draw (amp)	Time to move Travel Distance when under load (sec)	Loaded Linear Speed (in/sec)	Loaded Linear Speed (ft/sec)
30	11.41	0.28	25.14	2.09

Mechanism Unloaded Performance Outputs:

Stall Load (lb)	Time to move Travel Distance when unloaded (sec)	Linear Free Speed (in/sec)	Linear Free Speed (ft/sec)
127.87	0.21	32.86	2.74

We mounted the linear slide on to the robots



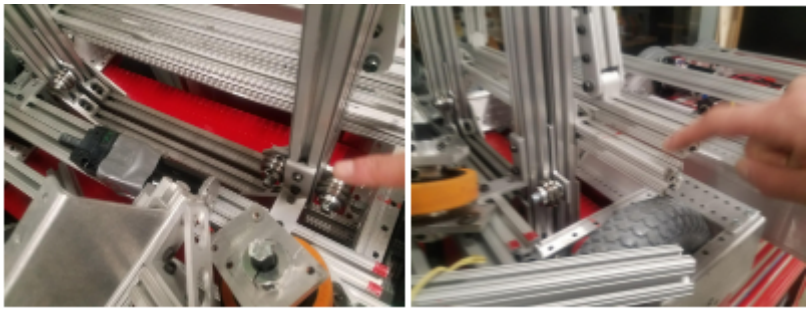
Meeting February 2, 2018

Today we worked on building our motor setup to pull and push the box intake up and down. We worked on a design in which we would use a pulley system to lower and raise to manipulator. First, we had to fix the linear slide, which was assembled incorrectly (an L bracket was put on backwards) When we rebuilt it correctly, we found that box manipulator was scraping on the wheel at the bottom, so we raised the box manipulator 0.5 inches off the ground. Next,we took apart most of the box manipulator (which we would later realized was a mistake), because we had to tighten it, get measurements, and fix a stripped screws. Jackson made us new screws (thanks), and we were able to partly put the manipulator back together. We found that the original standard L 90 degree brackets that we used were pushed in to an 85 degree angle. We replaced them with reinforced brackets.

We worked on gearbox and weight calculations to figure out the power to torque ratio that we will need to easily move the box manipulator. Next, we found that the current mechanical stop would not suffice. Shiv worked on a new stopping system along with Dave S.

Weight: BAG Motors- 0.71 lbs
Versa Planetary
Gearbox- .36lbs ***x2
BAG Motors- 1.42 lbs
Versa Planetary Gearboxes- .72 lbs
Motors and Gearboxes- 2.14
Total 80/20- 3.392 lbs
Hardware ≈ 0.5
Wheels- 0.269 lbs
Total- 6.301 lbs

This is the space we have to work with for the pivot mechanism



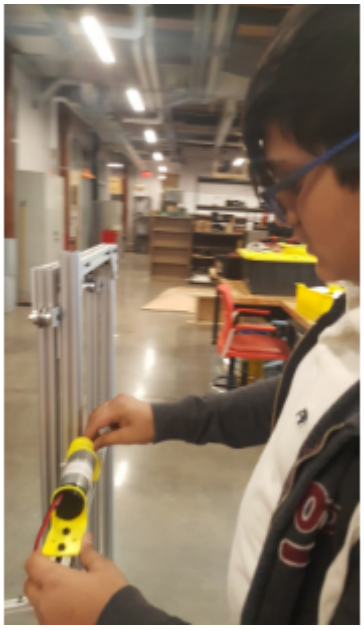
Meeting February 4, 2018

WE NEED TO ORDER MORE WHEELS FOR THE INTAKE, HERE'S THE LINK

http://www.andymark.com/4-Compliant-Wheels-p/am-4compliant.htm
Compliant bore - $\frac{1}{2}$ inch hex
Compliant durometer -35A (Green)
We need to buy more 4.75 lb springs

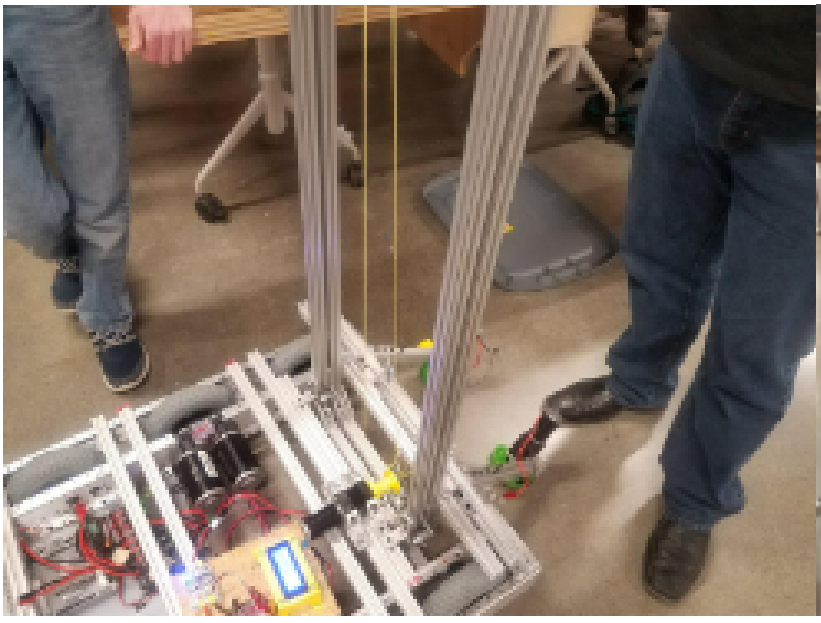
Meeting February 5, 2018

We made a mechanism to make the box intake go up and down. Link below https://drive.google.com/file/d/1dzhA14XuNRdLbzqoTiL2rMi-8pNhBgKk/view] It is run by string with a motor spinning to go up and down



Meeting February 6, 2018

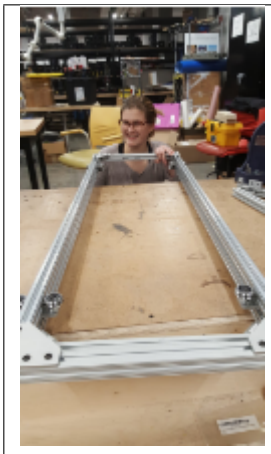
Continued to work on mechanism to lift the box intake. Made it stronger
We also strung the slide



Meeting February 7, 2018

NO MEETING SNOW DAY. UML CLOSED

Meeting February 9, 2018



We supported the linear slide better at the bottom. We still need to add the bottom pulley. We also need to add a support bar from the top of the linear slide to the back of the robot. Started making the linear slide for the second robot. Kataya and Alex started to cut 8020 for the second box intake for robot 2.

Meeting February 11, 2018

No work on box intake because we helped wire the robot with electrical
Linear slide attached to second bot

Meeting February 12, 2018

No work on box intake because we helped wire the robot with electrical

Meeting February 13, 2018

Started to CAD box manipulator in its final places on robot we also helped wire the robot with electrical

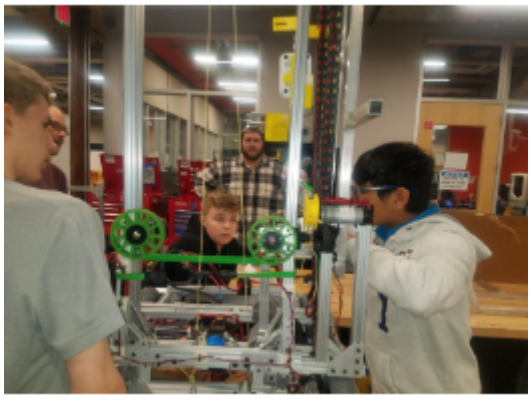
Meeting February 14 & 15, 2018

Wired box intake and lift with electrical

Meeting February 16 & 17, 2018

In its current position, the pivot mechanism hits the wing. We need to move it in or find a different way to mount the motor.

We moved the motor and flipped so it is no longer in the way of the wings. We added a wheel in the back for additional support of the box. Success is questionable.



To-Do:

- Test box manipulator (hold and drive)
- Test box manipulator (lift)
- Test box manipulator (deploy)
- Test box manipulator (box from floor, orientation 1) flat on ground
- Test box manipulator (box from floor, orientation 2) smallest orientation
- Test box manipulator (box from floor, orientation 3) biggest orientation
- Test box manipulator (box from portal)
- Fix issues with radio placement

Meeting February 19, 2018

Today we will improve the box manipulator. Our goal is to replace the string on the list first. We need to replace it because we attempted to use a blowtorch to strengthen the knot, but all it did was frail the end of the string.

We got new string, and we will mount it today.
The string that was originally on the robot was 8 feet, so we will use 8 feet on this rope. Yesterday, Bradley CADed a mount for the rear wheel. Jackson went to the second makerspace to mill them, but the CAD files did not send, so we will not have the part today. We will continue to use the wood mount for the rest of the day for testing

Meeting February 20, 2018

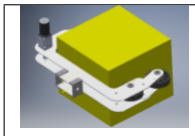
We tested the box manipulator and slide before bagging. Its grip on the box is weak. We can pick it up from any position, but it's still kind of wonky. We also need to address the issue of autonomous. We cannot possess boxes at the start of the match. We need to fix this somehow.

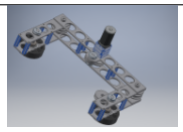
- Restrung the slide
- tested the box manipulator
- chopped nub off that's hitting wing on slide
- We never put an encoder on the lift, we need to do that or put on a limit switch

Future Stuff
We are overweight by 4 pounds. So our robot needs to go on a diet.

Meeting February 25, 2018

Our meeting was in the conference room today. We worked on CAD for a new box manipulator. There are three designs so far:





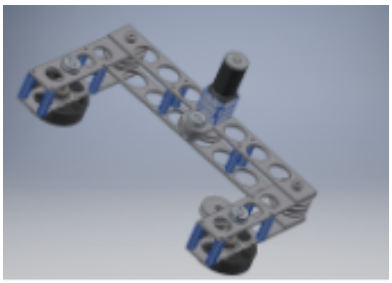
Meeting February 27, 2018

- We continued working on the CAD for the box intake.
- We have decided to go with one motor and polycord to drive both sets of wheels.
- We laser cut our first version.
- Shivi worked on the pivot mechanism - we will no longer use a pulley, we will direct drive it.

Meeting March 1, 2018

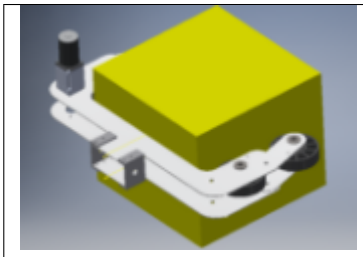
- -We tried to assemble the first version of the laser cut manipulator.
- CAD continued
- We designed the mounting mechanism for the slide and pivot points

This is the model of the integration with the slide and planetary gearbox instead of the original redline motor.



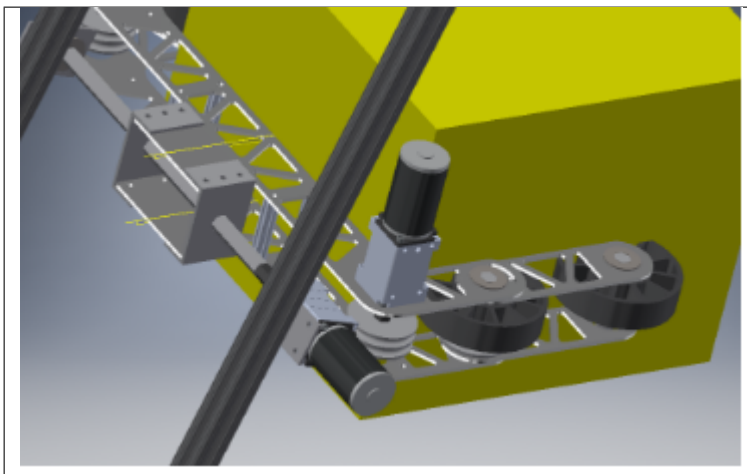
Meeting March 4, 2018

- We continued CAD work and did the holes to make it lighter
- We assembled a new laser cut version, but we need more pulleys.

	**Additions:** Lightweighting holes Mechanical stops (slots) Springs More supports?

Meeting March 6, 2018

- We assembled the box manipulator to test before machining
- We added slots for mechanical stops
- We need to test with the polycord

	Testing without the polycord shows a lot of promise! Much better grip on the box. Grip on the box could be better the short way though.

A smaller and lighter version is being worked on and will be finished by thursday. 1 motor is being used to power both wheels and another motor is being used to lift the intake back into our frame perimeter. Work is being done to finish this model.

Weight reduction:
New Box intake:
$\frac{1}{8}$" Dibond = .781 lbs/ft2 = .0054 lbs/in2 → .0054 lbs/in2*(41.1 in2*2+8.2 in2*4) = 0.621lbs
Compliant wheels - .228 lb/each → .228*4 = 0.912 Gearbox - 0.74lbs
Delrin - .0513 lbs/in3 → .0513 lbs/in3(4*2.39in3 + 2*1.48in3) = 0.638
Bag motor - .71 lbs
Bearings - 0.05lbs/each = 6*.05
lbs/each = .3 lbs Hex shaft = 0.027lbs/inch * 3 * 6 = 0.5lbs
Churros = .013 lb/in * 8 * 2.375 = 0.25lbs
Brackets - 2.7 g/cm^3 → 2.7 g/cm^3 * 19.13cm3 * 2 = 103..3 g = .23lbs
Polycord - ¡.25lbs
Total = 5.14 lbs
Original Intake:

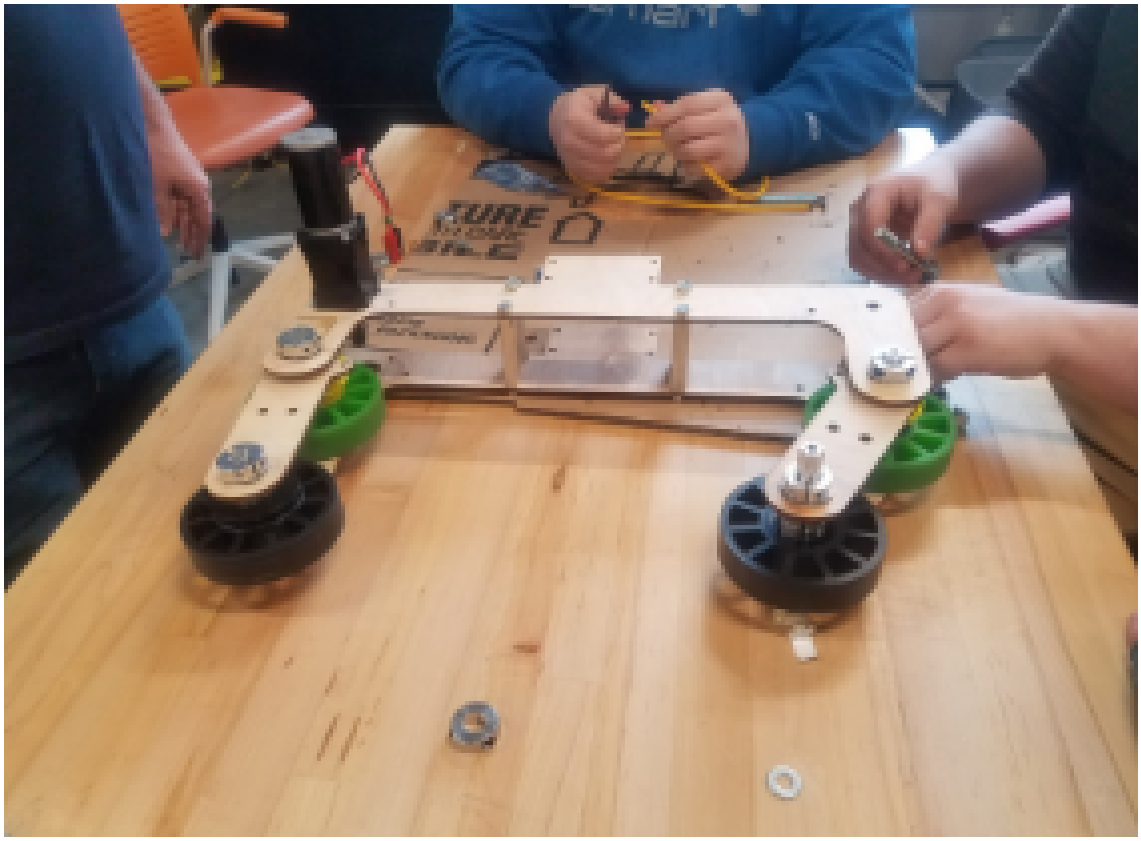
8020 - 0.0424lbs/in → 36in*0.0424lbs/in = 1.53lbs
2 x 2 corner brackets- .08 lbs/each = 4*08 lbs/each = .32lbs
Pivot 8020 things - .312 lbs/each → .312 lbs /each * 2 = .624 lbs
Other pivot things - 0.291 lbs/each → .291 lbs/each *2 = 0.582 lbs
Bag motor - 0.71 lbs/each → 2 *0.71 lbs/each = 1.42lbs
Gearbox - .74 lbs/each → 74 lbs/each * 2 = 1.48lbs
Compliant wheels - .228 lbs/each → .228 lbs/each * 2 = .456 lbs

Mounting Brackets - 6.98in2/each * 3.64 lbs/ft2 * 2 *1ft2/144in2 = .353 lbs
Hex collars - 0.04lbs/each → 2 *0.04lbs/each = 0.08 lbs
Total = 6.85 lbs

Additional loss:
1 Motor Controller : 0.26lbs (talon SRX)
Original Weight - 6.85 lbs Total difference: 6.85lbs - 5.14lbs + 0.24lbs = 1.95lbs

Meeting 11, 2018

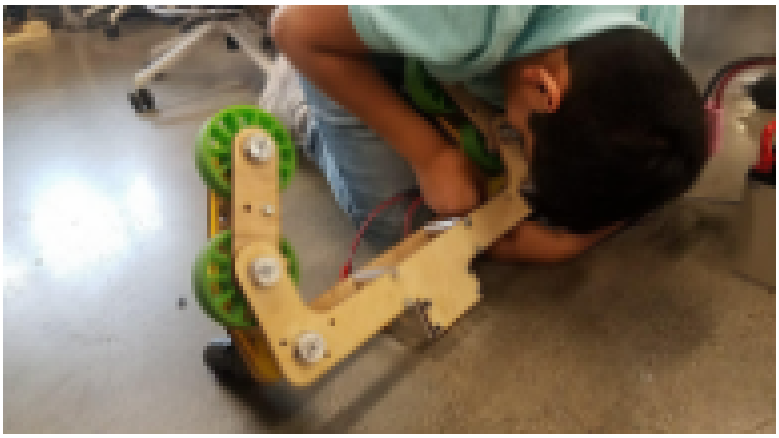
- We built the new box manipulator
- We tested the new wooden box manipulator

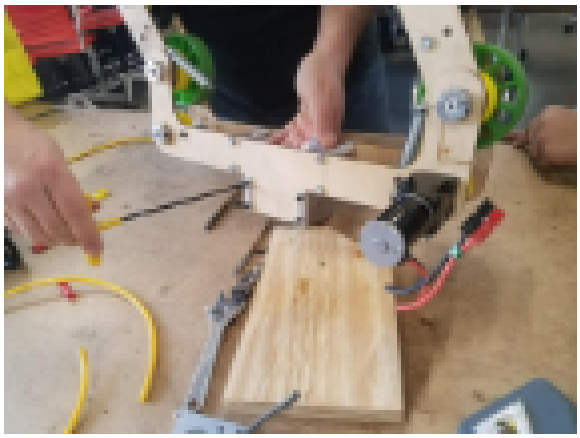


Putting the belts on the pulleys. The polycord tends to slip. This caused problems when trying to use only one motor. We decided to switch to two motors instead because they weren't grippy enough.

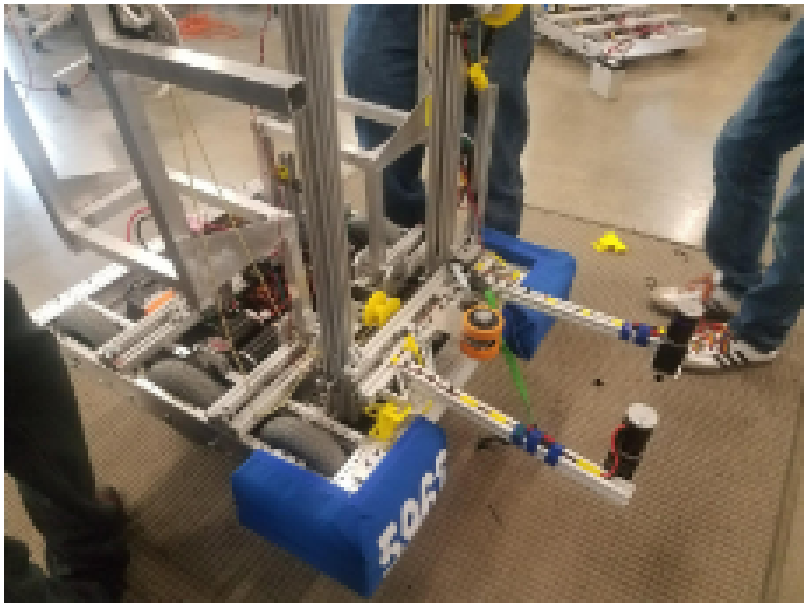
Final work on the box manipulator in CAD

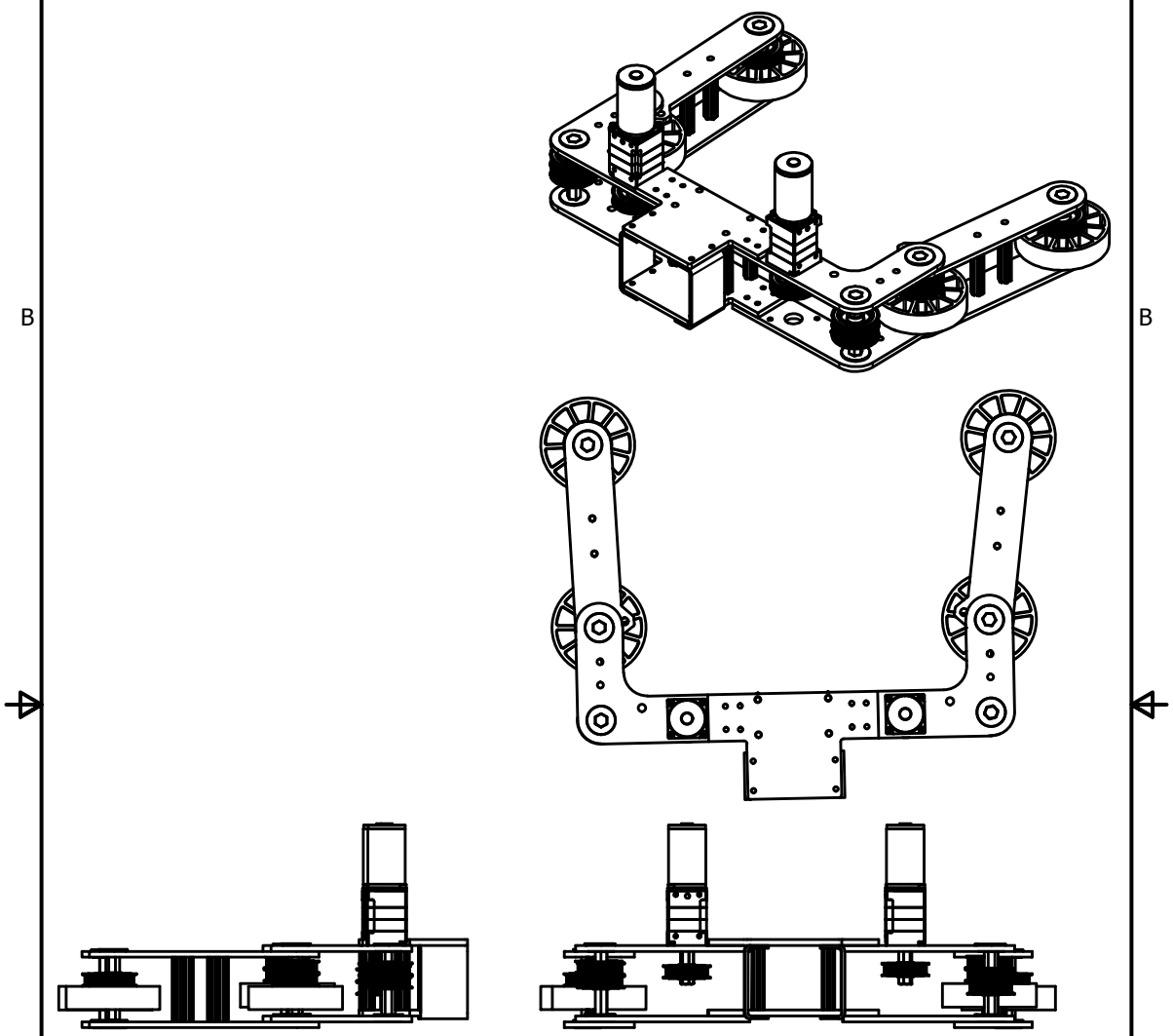
After moving the motors the box manipulator could fold in. We also had to make the pivot brackets longer so it could fold in all the way.





We moved the motors to the center instead of the outsides so they would not interfere with the slide. This also kept them from interfering with the motor controller bar.





DRAWN Emily	3/31/2018			
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QA		TITLE		
MFG		Box Manipulator V3		
APPROVED		SIZE A	DWG NO boxmanipulatorv3	REV
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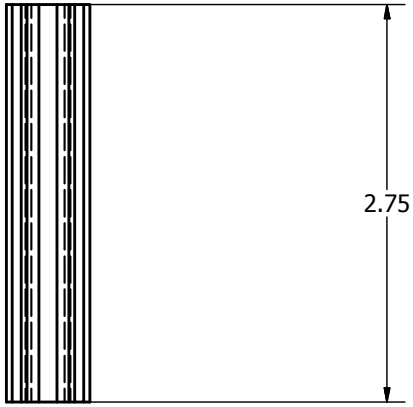

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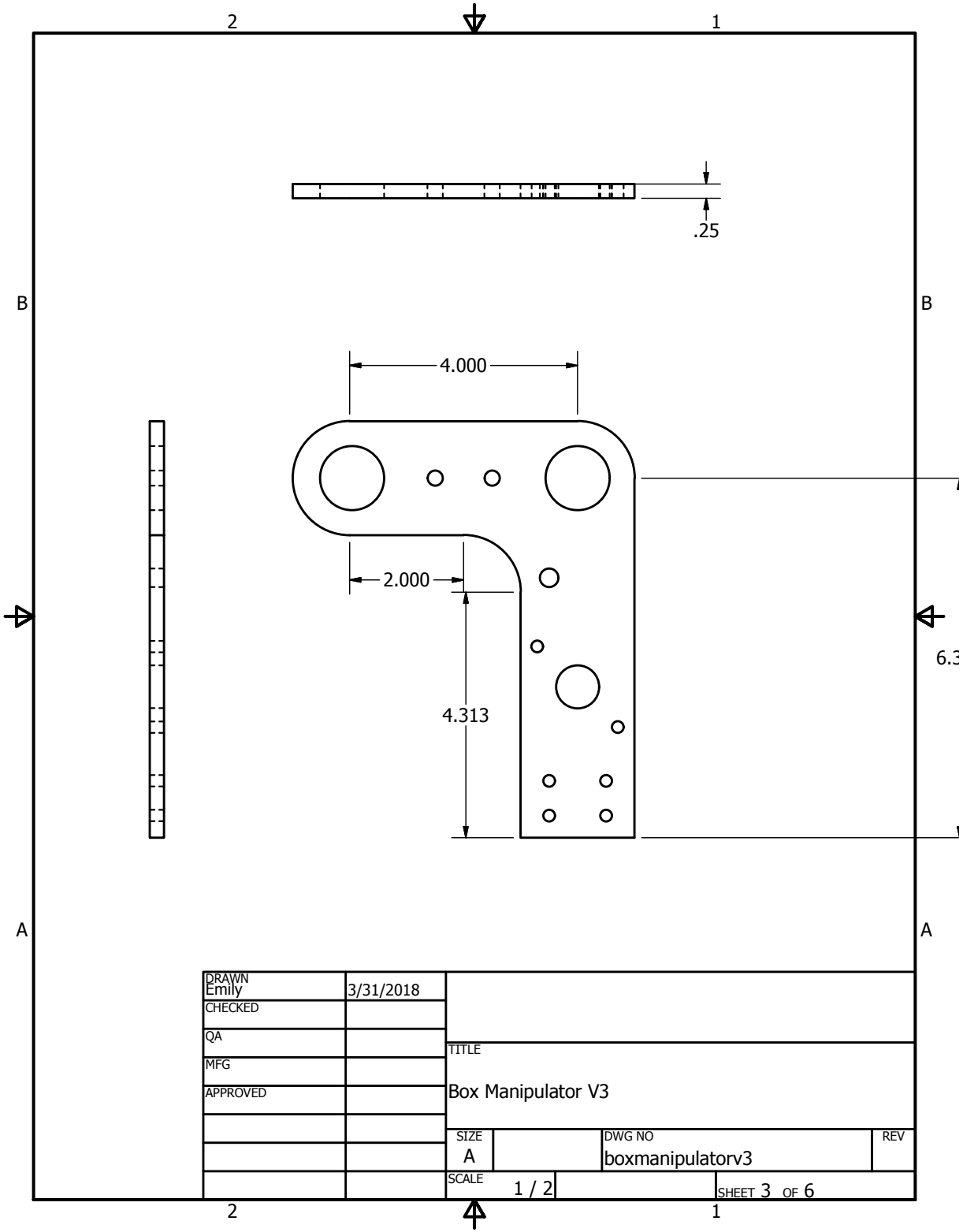
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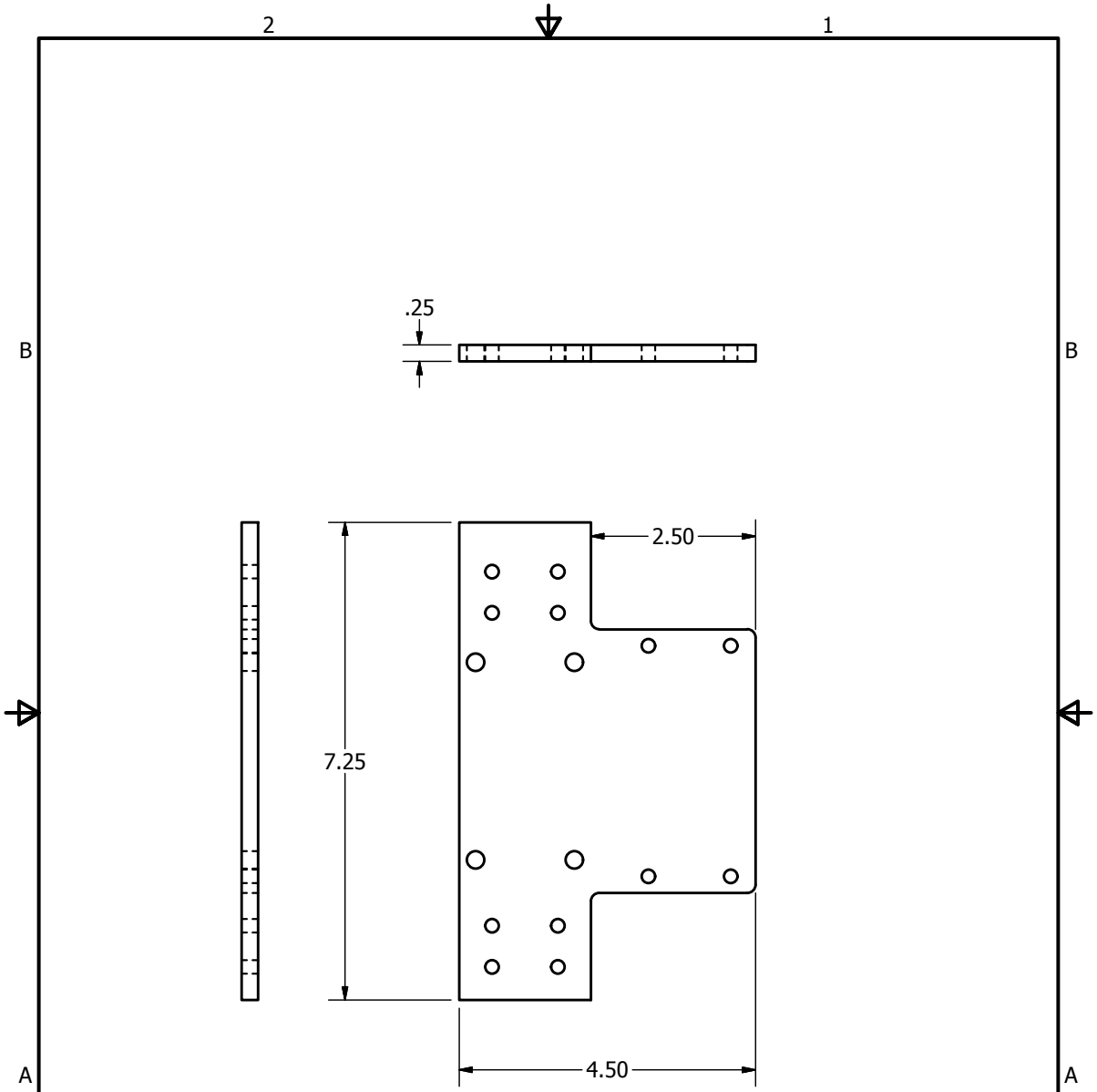

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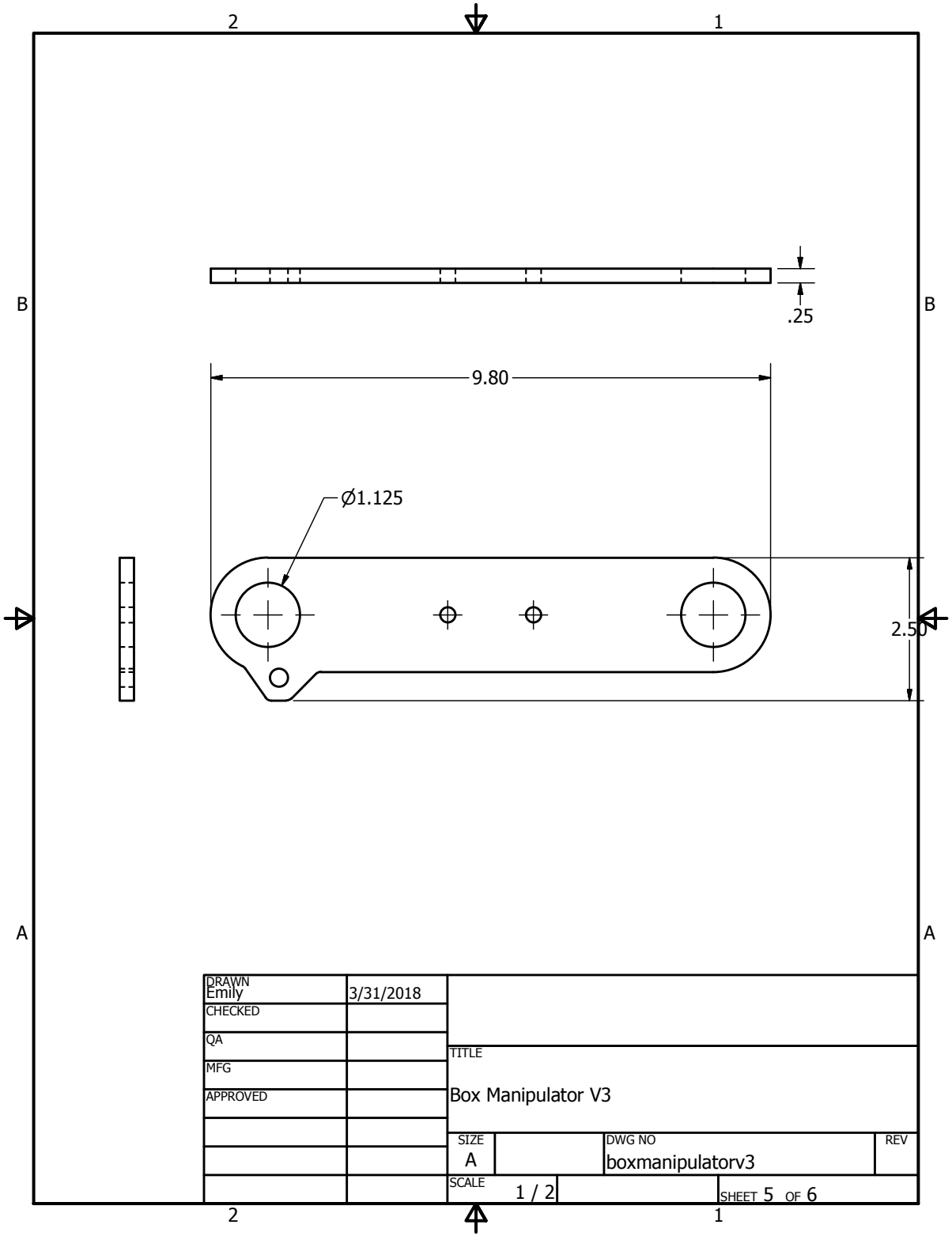
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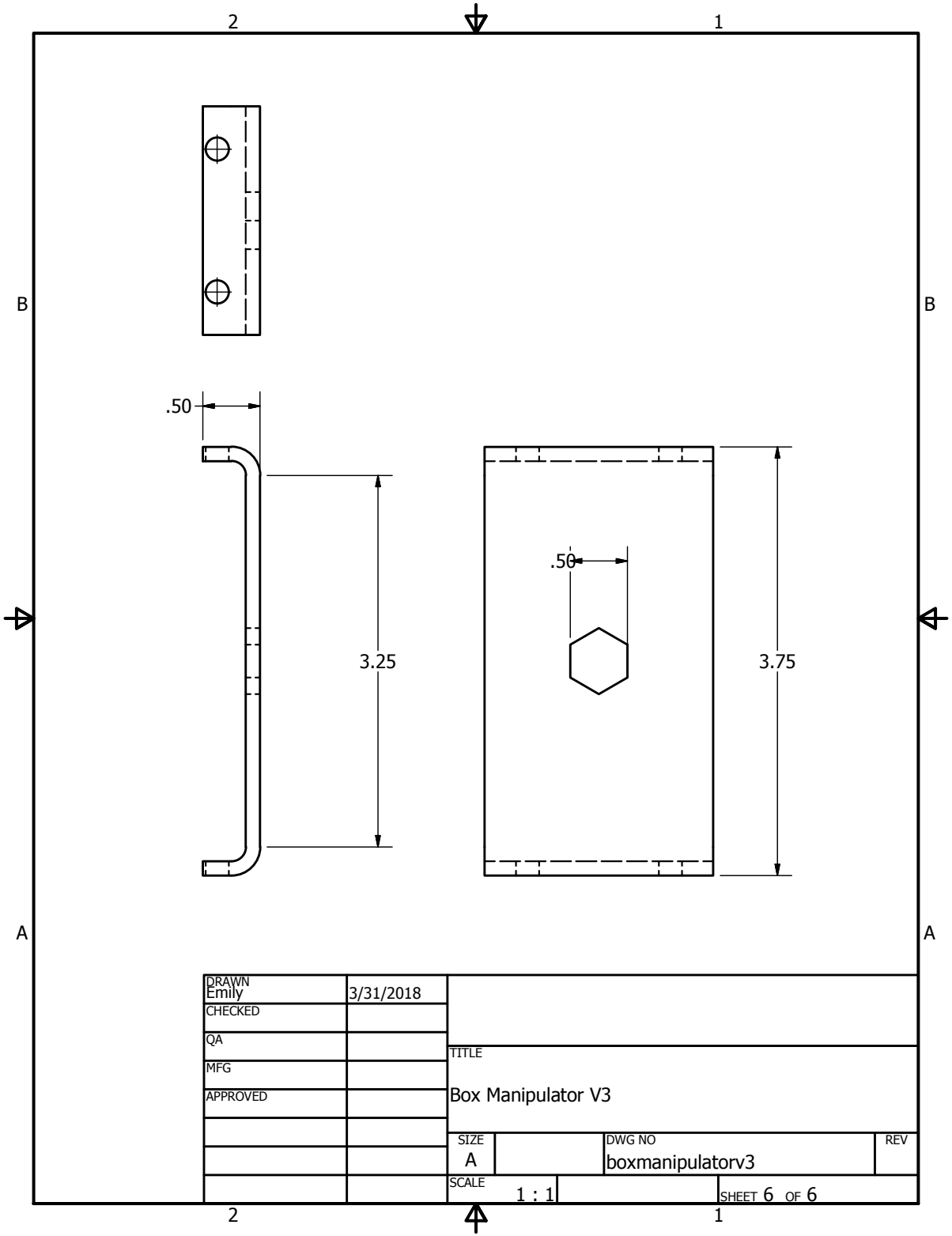
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Drive Train

Meeting January 6, 2018

https://firstfrc.blob.core.windows.net/frc2018/Manual/2018FRCGameSeasonManual.pdf
R03. In the STARTING CONFIGURATION, the maximum ROBOT size (excluding BUMPERS) must be constrained to a volume of 33 in. by 28 in. by 55 in. tall (83 cm by 71cm by 139 cm tall)
R04. ROBOTS may not extend more than 16 in. (40 cm) beyond their FRAME PERIMETER (see Figure 8-1), except during the ENDGAME (see G05).

Speed	8	It is given a 8 because we want a quick robot so it can go from point A to B so we can score faster.
Weight	5	It is given a 5 because we want a light robot to scale and the chassis should not weigh too much because manipulators would be added on exceeding the 120 lb limit.
Maneuverability	7	It is given a 7 because you want a robot with easy maneuverability around obstacles.
Torque/Push/Power	8	Its is given a 8 because you want a robot that can also contain its territory.
Complexity	9	It is given a 9, because it is easier to use and maintain.
Durability	10	It is given a 10 because we want to have it long lasting and not be needing repairs every match, constructing it of a good material
Volume	10	It is given a 10 because we want to maximize all the available space left for the manipulators.
Cost	6	It is given a 6 because we do not want to go over budget.

Meeting January 7, 2018

CAD new mounting plate for 3 ball CIM its 109.99 for 1 https://www.vexrobotics.com/3cimballshifter.html
High Ratio - 20 feet per second
Low Ratio - 8 feet per second

The kit chassis will work

Super sonic shifter on andymark here's the link it's 319.00 for 1
https://www.andymark.com/super-sonic-2-speed-gearbox-p/am-3039$_45.htm$
High Ratio - 19.4 feet per second
Low Ratio - 7.7 feet per second

Drive Train Wheel Chart

	Standard KOP 4"	Standard KOP 6"	8" Pneumatic Wheel	Mecnum	Omni
Hold Position	8	8	10	3	4
Maneuverability	5	5	5	10	9
Volume	9	7	5	6	9
Rough Terrain	5	5	9	2	5
Total Score	27/40	25/40	29/40	21/40	27/40

Making CAD files of designs on MVR 11 Laptop Omni wheel
http://files.andymark.com/PDFs/DuraOmni+Spacer+Chart.PD

Pneumatic Wheels
http://files.andymark.com/LayoutPrints/am-14u3-pn8$_Pnuematic_Wheel_Upgrade_Kit_V3.PDF$

Meeting January 8, 2018

Tasks for today

- Make plate for vexpro 3 cim ball shifter
- Research drive trains and decided on wheels

We worked on the inside plate for the drivetrain and will finish it tomorrow or Wednesday. We have to purchase the gearbox as soon as possible if we want to have a faster drive train. CAD files were added to the hard drive.

Meeting January 9, 2018

Tasks for today

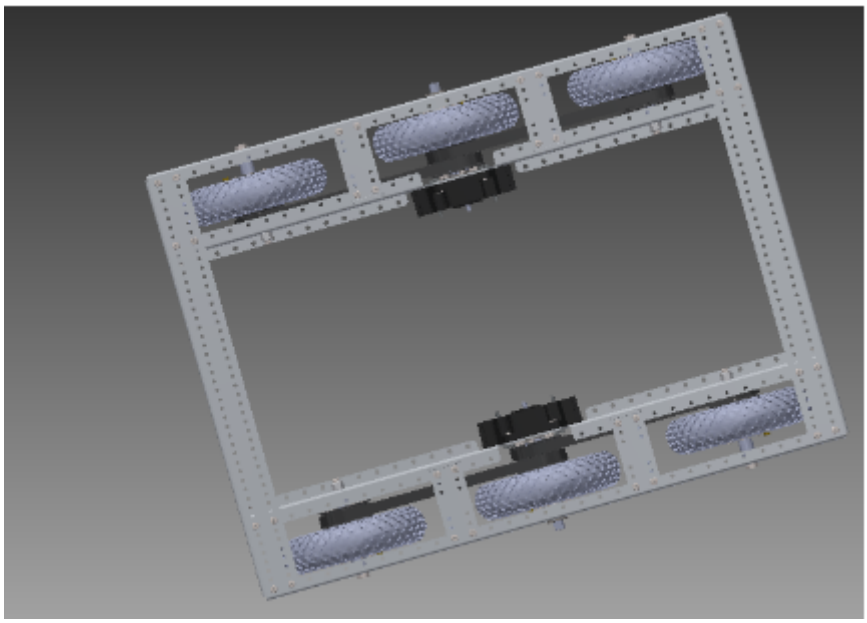
- Finish the inside plate - We will not be making the plates because they would be way too expensive for the team this season.
- Start order for gearbox

We have decided to go with a Pneumatic Wheels and the Super Sonic Shifter on AndyMark with the standard kit chassis

WE NEED

	Link	Cost	Quantity	Total
Sonic Shifter	(am-3039$_4$5)$https://www.andymark.com/super-sonic-2-speed-gearbox-p/am-3039_45.htm$	319	2 or 4 ?	638 or 1274 ?
8" Pneumatic Wheel (am-0970)	http://www.andymark.com/8-inch-pneumatic-wheel-p/am-0970.htm	37	6 or 12 ?	222 or 444 ?
Total				860 or 1718 ?

Shaft doesn't extend all the way through the wheel Right now supersonic shifter is out of stock
Might need to look at other gearboxes



Meeting January 10, 2018

To do:

- Find a gearbox or shaft that will work with chassis
- Find other solutions using Supersonic shifter

Accomplished

- We are using Pneumatic wheels
- Using toughbox mini with 5.95 gear ratio so we can move at 24 ft/second
- Steel Measured in back is 10 feet long by 3 inches wide by 1 inch tall
- Parts were ordered

Meeting January 11, 2018

To do

- Look more into steel supports
- Add cad file of chassis to hard drive
- Finish cad of robot

Accomplished

- Finished cad of robot chassis and added it to the hard drive
- Looked into steel and it would help to get steel beams for support on our chassis

Meeting January 12, 2018

Fixed chassis and downloaded it to hard drive

Meeting January 14, 2018

Part	Qty	Price	
Toughbox Mini (5.95 gear ratio)	4	308	http://www.andymark.com/tbmini-options-p/am-tbminioptions.htm
8" Pneumatic Wheel (am-0970)	12	444	http://www.andymark.com/8-inch-pneumatic-wheel-p/am-0970.htm
Upgrade Kit for 6WD 8" Pneumatic Wheels	2	328	http://www.andymark.com/AM14U3-p/am-14u3-pn8$_n owheels.htm$
AM14U3, FRAME ONLY (am-3293)	1	209	http://www.andymark.com/AM14U3-p/am-3293.htm
Total			1,289

Chassis parts will be in by Tuesday:
Chassis will be finished assembly by Wednesday to Thursday

Meeting January 15, 2018

we looked i to steel beams that would support us and help the box manipulator group

Meeting January 16, 2018

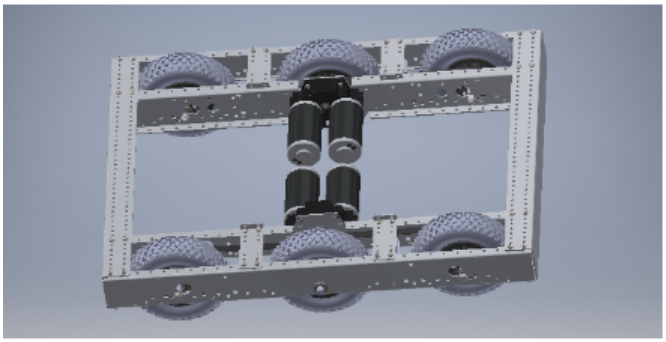
final check on chassis cad were done

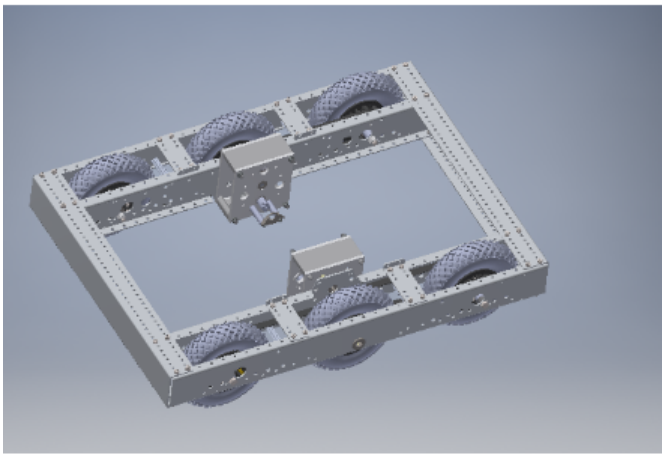
Meeting January 17, 2018

NO MEETING because UML was closed due to snowstorm

Meeting January 18, 2018

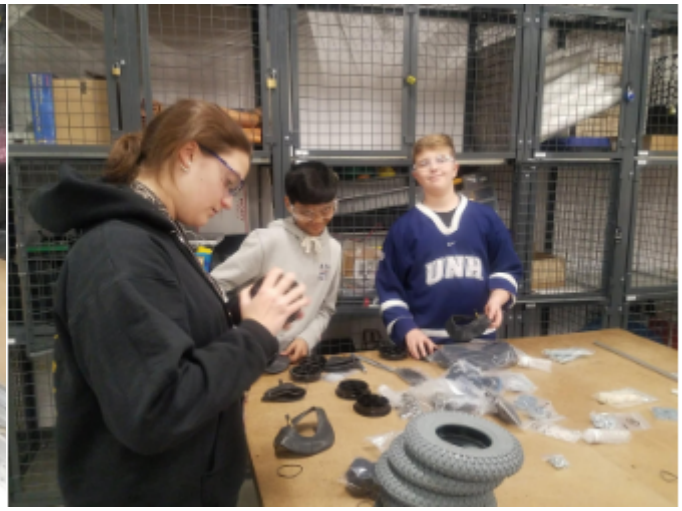
Chassis came : built wheels the whole time and took inventory.





Meeting January 19, 2018

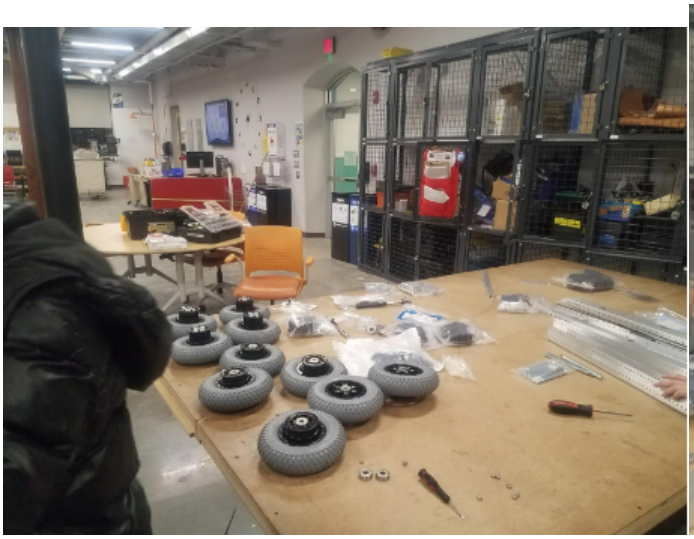
- Shaft broke so it will be glued back together by David Satterfield until a new one is shipped by Andymark in about 1 $\frac{1}{2}$ weeks from now
- Speaking about Andymark, a human error by their employees caused a wrong part to be sent which is a problem. Temporary solution is that the satterfield's will print 3d replacements parts until andymark can send us the right ones.
- Tap and die part broke but there was a replacement on the old set.



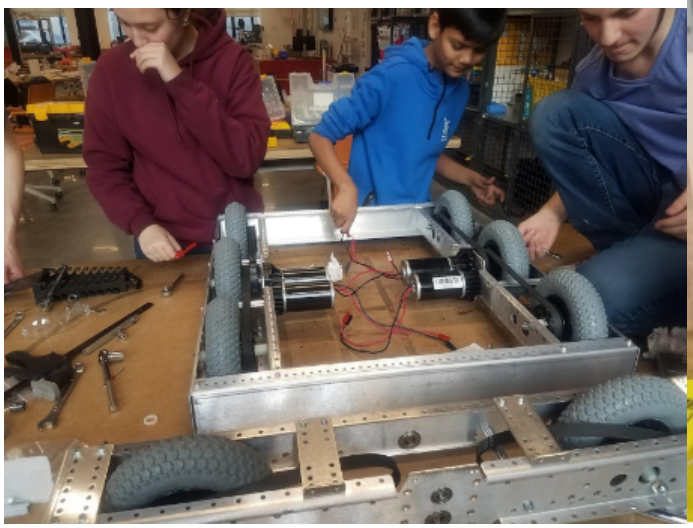
Meeting January 21, 2018

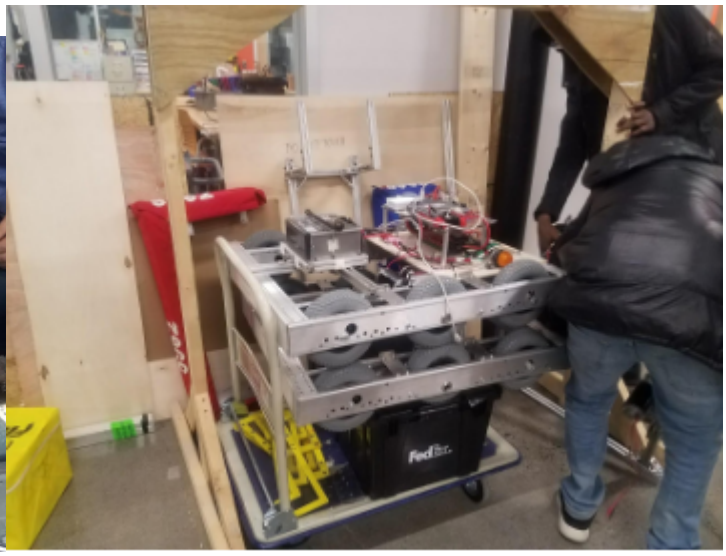
We finished 1 chassis to ship off to electrical to put on the electrical boards

Chassis has problem with gearbox and will get fixed at the next meeting.



Meeting January 22, 2018





Meeting 1/23/18

The gearbox was fixed and the issue was that the bearing was not fitting properly and grinding against the gears.
Missing spacer for 1 chassis part number (am-1151) might have to 3D print 1.
http://www.andymark.com/Electrical-s/41.htm

Meeting January 24, 2018

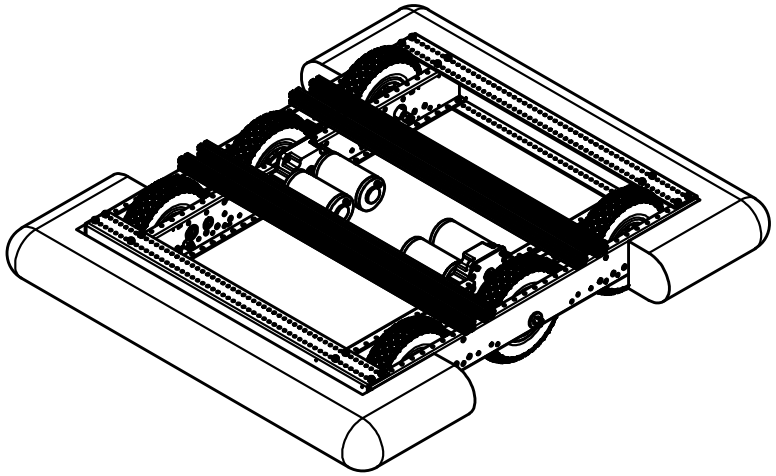
Cut pieces for the chassis support. Katya measure and David cut them.

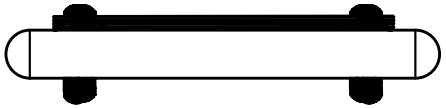
Meeting January 25, 2018

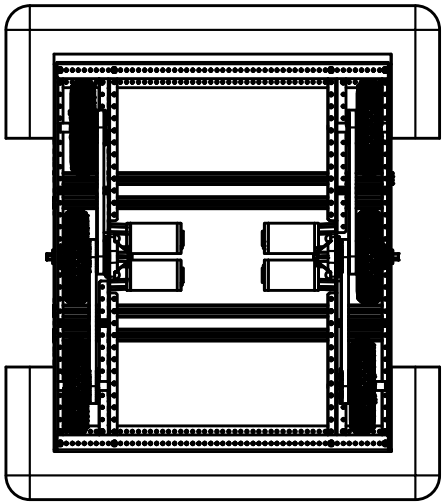
Added on the 4 8020 supports for the robot. The last pieces were cut for the support

Meeting January 26, 2018

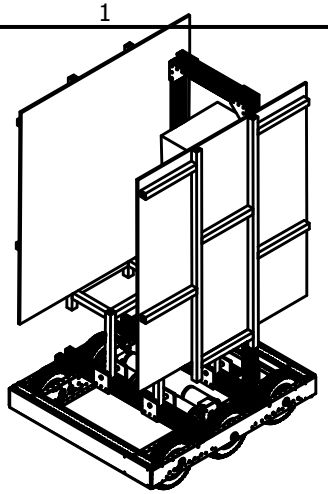
Fixed the battery mounts and fixed the electrical board back and gave the chassis of the software

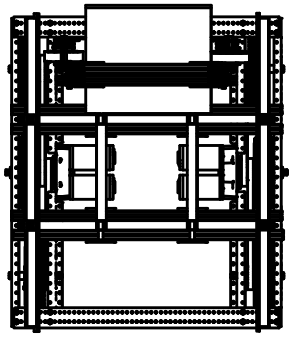


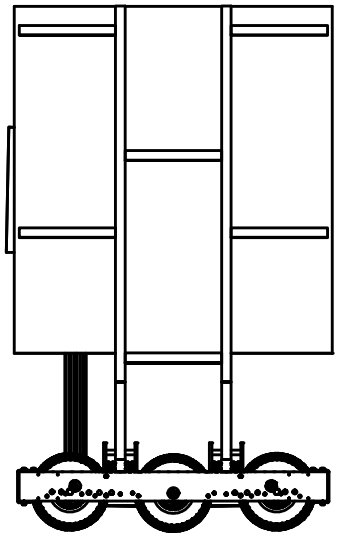


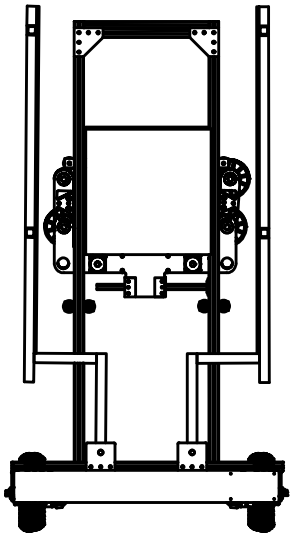


DRAWN Emily	4/1/2018			
CHECKED				
QA		TITLE		
MFG		Drivetrain		
APPROVED		SIZE A	DWG NO	REV
		SCALE 1: 12		SHEET 1 OF 2









DRAWN Emily	4/1/2018	
CHECKED		
QA		TITLE Drivetrain
MFG		
APPROVED		SIZE A / DWG NO / REV
		SCALE 1 / 15 / SHEET 2 OF 2

Climber

This is the documentation dedicated to the documentation of both of our winch and wing deployment mechanisms.

Meeting January 6, 2018

We did work on the climbing manipulator pew chart We need to Climb:

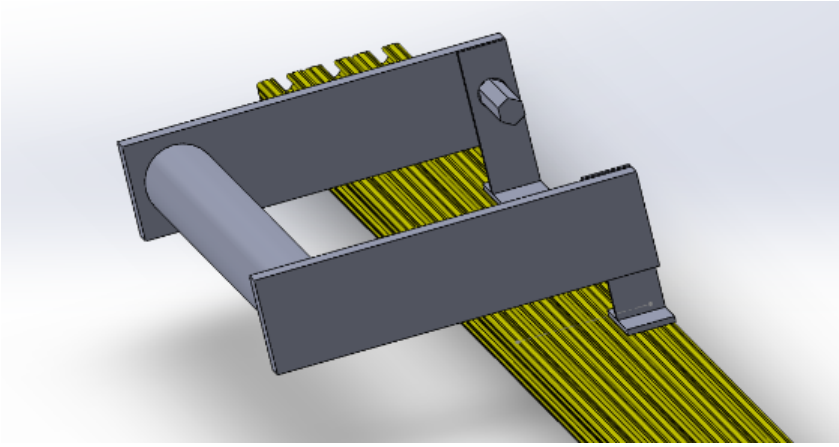
Criteria	Weight	Notes
Cost	5	Cost Effective
Starting Volume	3	Needs to be considered in relation to other manipulators
Time to deploy and climb	10	In seconds (30 max) lower needed for others to climb us
Structural Strength	8	Needs to be able to support weight of the robot (150 ish pounds) plus possible weight of other bots
Weight	5	In lbs
Position on the bar	6	At least have one other team in mind
Total	36	

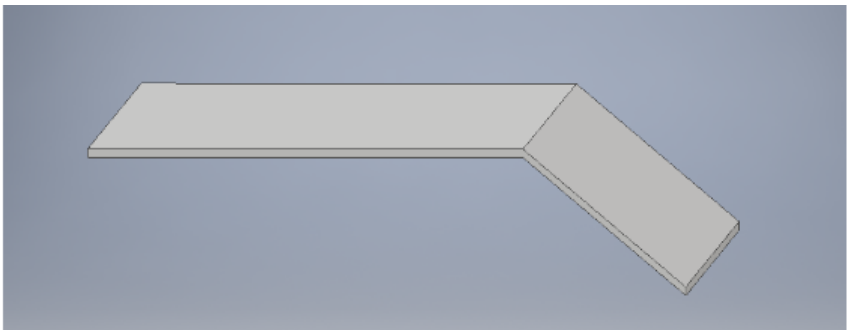
Letting Others Hang

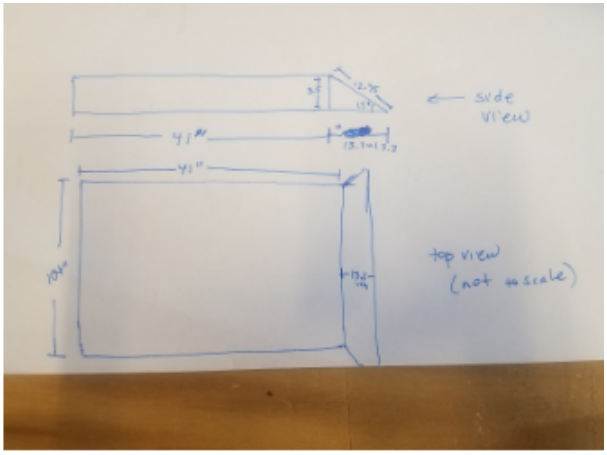
Criteria	Weight	Notes
Amount of Bots that can Hang	0,6, or 8	0 for none, 6 for one, 8 for two
Structural Strength	6	Must be able to hold 1-2 other robots
Weight	5	
Cost	5	Cost Effective
Starting Volume	3	But still depends on how many other manipulators exist on the robot
Does it prevent us from hanging?	yes/no	If yes then levitate must be used
Total	26	

Meeting January 7, 2018

- Winch system
- Wheels on back to keep steady on ramp
- Pneumatics to push off up with robots on ramp
- Bar on our robot for another bot to hang on
- Must actually be supported by the rung
- Collapsing arms
- Thinking of getting hook up but does not bear weight
- Pneumatics for collapsing
- No touching rung, double drop down ramps with hinged angled piece on side







The Scale: The scale is surrounded by platforms: 104 inches long x 41 inches deep x 3.5 inches tall Ramps leading up to the platform is 12.75 inches long @ 15 degree angle

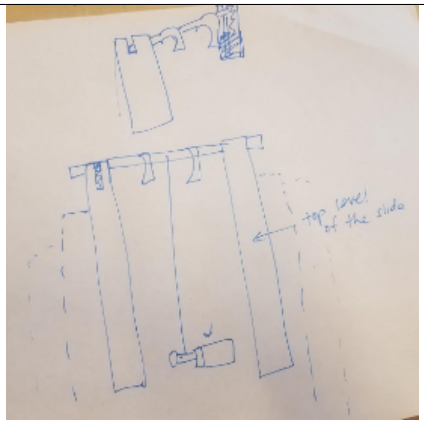
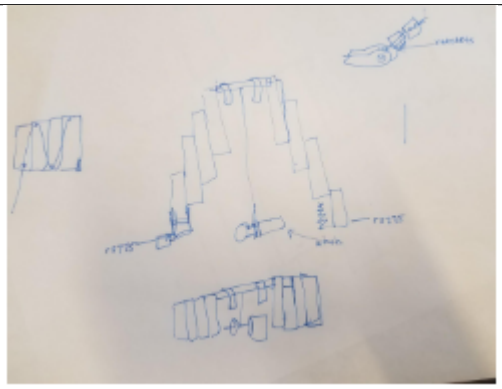
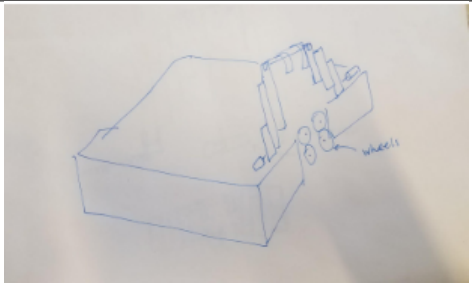
- Scissor Lift: https://www.youtube.com/watch?v=dA33tRqgWUc
- Uses two motors and a screw mechanism to expand the scissor lift - kinda slow
  https://www.youtube.com/watch?v=DC04oPm5P2g
- Uses tension and a motor to expand the lift
  https://www.youtube.com/watch?v=OWdMRPmAENQ
- Uses a motor and screw mechanism to scale (small and kinda slow, but controlled)

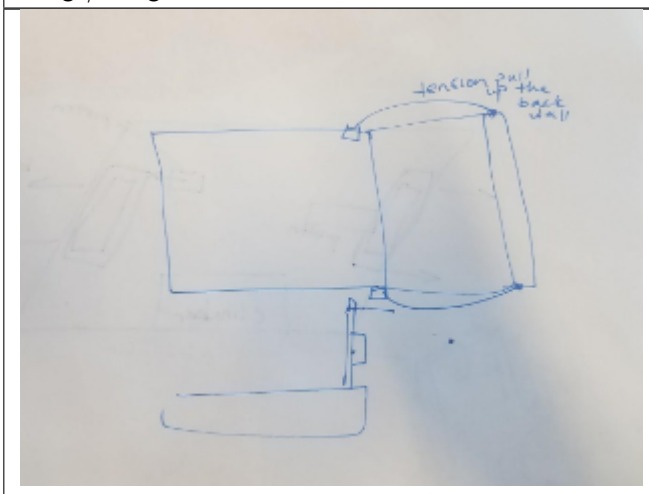
- Screw Linear lift?
  https://www.youtube.com/watch?v=IKJYuBXahQo
- Uses a screwing mechanism to raise up

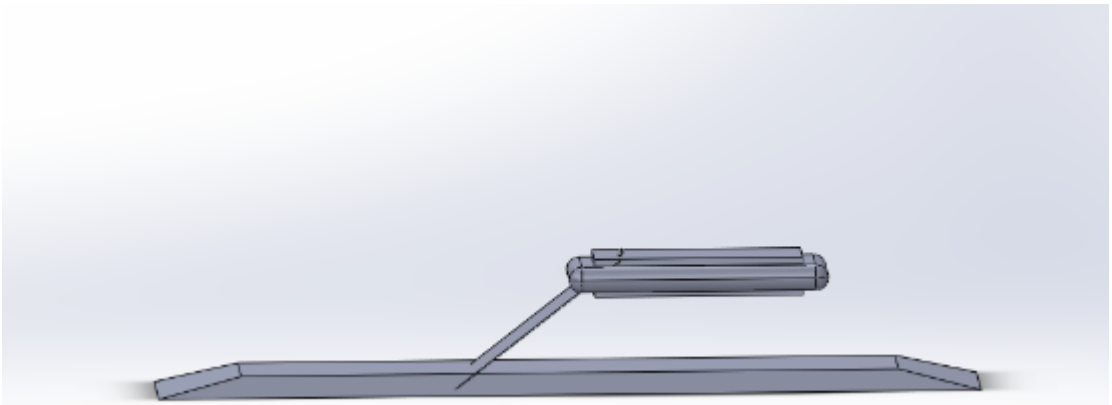
- Similar to a 3D printer Linear Slide:
  https://www.youtube.com/watch?v=wgTp5y3qT88
  https://www.youtube.com/watch?v=mbSP4dkfD2g
- Uses tension to raise multiple bars of 8020, motor pulls the string that elevates!!
  https://www.youtube.com/watch?v=E8G0eduOfRYt=152s
- Tutorial on how to build linear slide

Pulling Ourselves Up
Winches!
If we just pull ourselves up:
Piston:
https://www.youtube.com/watch?v=Yy82QFDHhgc

Holding ourselves up:
How much torque can a ratchet take?
https://www.bikechatforums.com/viewtopic.php?t=222675
https://www.ford-trucks.com/forums/352105-how-much-torque-can-sockets-handle.html
"It kinda depends. If you've got a cheap chinese socket, it might not take as much as a snap on or craftsman. I have personally stuck a craftsman spark plug socket on a bolt, attached a 4 foot breaker to it and jumped on it, without it breaking. Snapped off the bolt. And I weigh 180 lbs."
Lowest Angle for 2 ramps at 12": 57.5 (length=14, height= 22)
Lowest Angle for 1 ramp at 12": 33.7 (length=33, height=22)
Lowest Angle for 2 ramps at 0": 40.6 (length=14, height=12)

Image/ Diagram	Description
	Linear slide would carry a hook caught between two divots on the 8020. Once caught on the hook, with the slide descending, the hook would get caught and would winch it's way up.
	Linear slide with a winch and two hook bar.
	We could put wheels running up the back of the robot to help create horizontal friction and reduce vertical friction on our ascent.

Image/ Diagram	Description
	The ramps that we release to hold other bots could be help up during the match with tension. Then a motor could release them.



Ramp deploy?

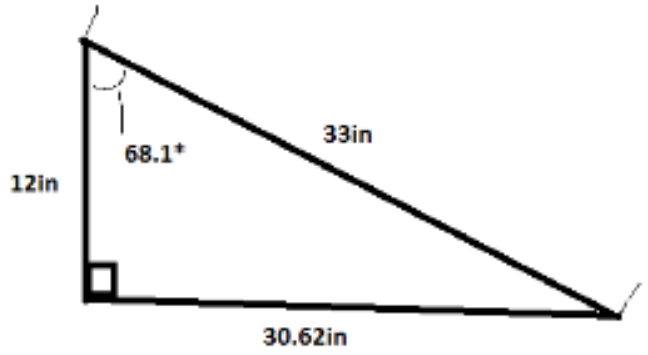
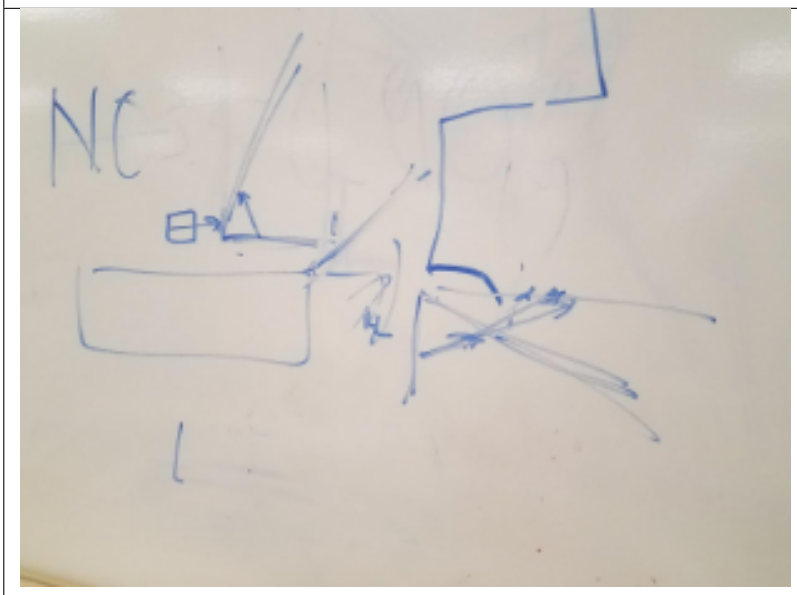
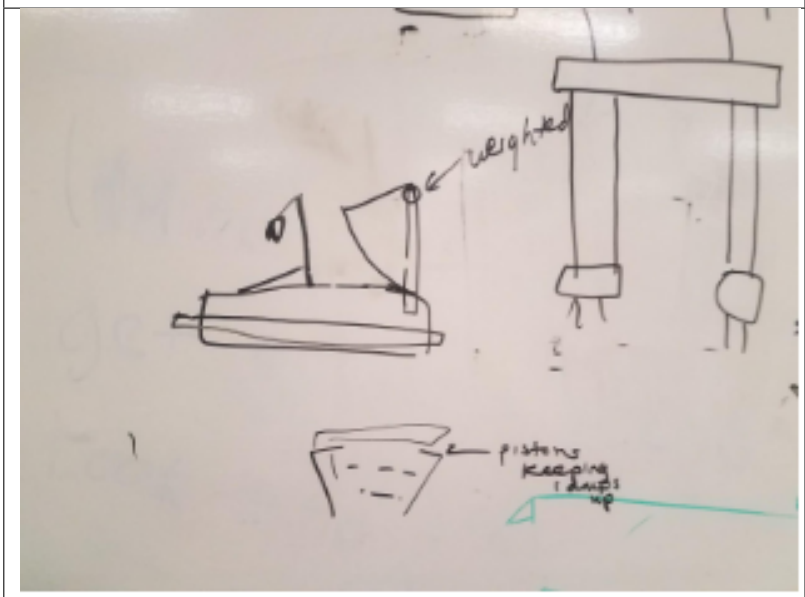
Two Strings/ropes for stability?
Difference between hold and pull?
Hold: act of not falling down when up
Pull: act of moving robot up
Gas springs? Mechanical stop? Stabilizing?
Velcro? Center everything.... Slides? Rotates up to desired heights?
Combined not multiple manipulators. Slide like gear box? Small pistons to retract them and weight at end to naturally fall. L-shape pistons. Naturally fall? Swinging too much? Ratcheting truck ties with beefy hooks. Do we need to potentially pull? More speed if lifting own robot. Long distance for reason. Sacrificing room for bot? Potentially switch both of hang and helping. Trade of for losing pints with no one to defend switch and scale.
Test with old bot on two truck ties and see if hang and test swing. Two truckties on motor and half robot way with robot driving halfway up

Initial Prototyping:

Is holding even plausible? To test we need to make sure the swing generated from a winch is not too much that a robot would not be able to drive up us.
Materials:

- Truck ties spaced 1 foot apart
- Wheels to put on back of robot. Does this make it better and increase friction?

Meeting January 9, 2018

	If we have a 33inch ramp, we will have a 68 degree angle. The horizontal coverage is 30.62 inches.
	Pneumatically deploy a ramp and raise once the other team climbs aboard, we would push it out with a piston and it would be at an angle with a fixed angle. By activating the ramp piston, we would raise the other team up.
	Two ramps that are naturally weighted would be released when in the air. Then they would drive up and be on us above 12 inches.

WINCH SWAY TEST RESULTS

- Attached at front with no wheel

  Extreme backwards tilt

  (approx 70 degree) Too much to hold robot without even having another bot on it.

New Lift Option if no winch http://www.revrobotics.com/rev-25-1239 220

https://www.youtube.com/watch?v=zdbHmhbirNg Piston raising and lowering a ramp. Perhaps we could do this?

Meeting January 10, 2018

- Order pneumatic parts
- Do piston calc
- Discuss design
- CAD?
- Plate material?

Motor Calculations for the Winch

Linear Motion Gearing Design Calculations

Motor Specs

Spec Voltage (V)	Free Speed (RPM)	Stall Torque (N*m)	Stall Current (Amp)	Free Current (Amp)
12	5700	2.43	133	2.7

Mechanism Gearing:

Driving Gear	Driven Gear	Reduction
1	50	0.020
1	1	1.000
1	1	1.000
1	1	1.000

Overall Gear Reduction	
0.0200	50.0 : 1

Mechanism Physical Chacteristics:

Applied Motor Voltage (V)	Load Torque Lever Arm (in) [Pulley Radius]	Gearbox Efficiency	Travel Distance (in)
12	0.5	80%	12

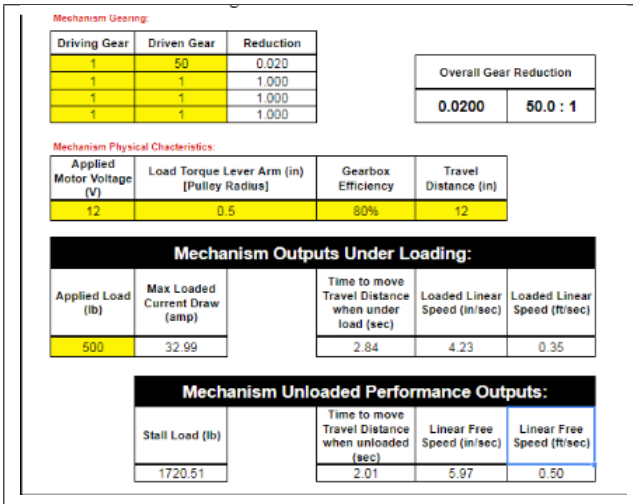
Mechanism Outputs Under Loading:

Applied Load (lb)	Max Loaded Current Draw (amp)	Time to move Travel Distance when under load (sec)	Loaded Linear Speed (in/sec)	Loaded Linear Speed (ft/sec)
450	29.96	2.72	4.41	0.37

Mechanism Unloaded Performance Outputs:

Stall Load (lb)	Time to move Travel Distance when unloaded (sec)	Linear Free Speed (in/sec)	Linear Free Speed (ft/sec)
1720.51	2.01	5.97	0.50

Motor Calculations to lift 450 lbs. With a 50:1 gearbox and a CIM Motor, we could scale in 2.72 seconds with both robots attached to us.



Mechanism Gearing:

Driving Gear	Driven Gear	Reduction
1	50	0.020
1	1	1.000
1	1	1.000
1	1	1.000

Overall Gear Reduction	
0.0200	50.0 : 1

Mechanism Physical Chacteristics:

Applied Motor Voltage (V)	Load Torque Lever Arm (in) [Pulley Radius]	Gearbox Efficiency	Travel Distance (in)
12	0.5	80%	12

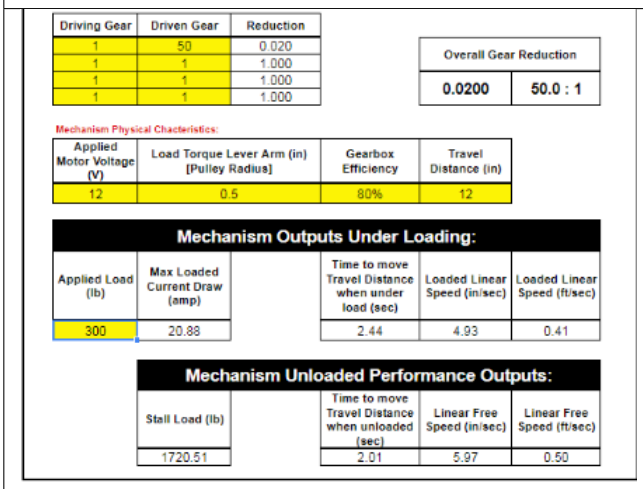
Mechanism Outputs Under Loading:

Applied Load (lb)	Max Loaded Current Draw (amp)	Time to move Travel Distance when under load (sec)	Loaded Linear Speed (in/sec)	Loaded Linear Speed (ft/sec)
500	32.99	2.84	4.23	0.35

Mechanism Unloaded Performance Outputs:

Stall Load (lb)	Time to move Travel Distance when unloaded (sec)	Linear Free Speed (in/sec)	Linear Free Speed (ft/sec)
1720.51	2.01	5.97	0.50

With 500lbs



Driving Gear	Driven Gear	Reduction
1	50	0.020
1	1	1.000
1	1	1.000
1	1	1.000

Overall Gear Reduction	
0.0200	50.0 : 1

Mechanism Physical Chacteristics:

Applied Motor Voltage (V)	Load Torque Lever Arm (in) [Pulley Radius]	Gearbox Efficiency	Travel Distance (in)
12	0.5	80%	12

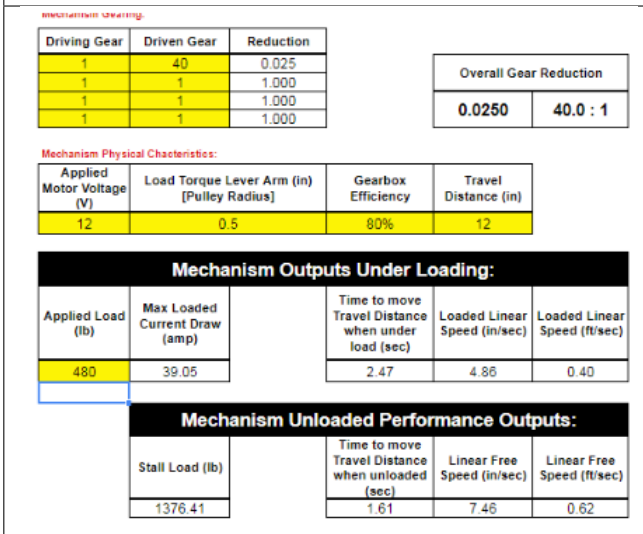
Mechanism Outputs Under Loading:

Applied Load (lb)	Max Loaded Current Draw (amp)	Time to move Travel Distance when under load (sec)	Loaded Linear Speed (in/sec)	Loaded Linear Speed (ft/sec)
300	20.88	2.44	4.93	0.41

Mechanism Unloaded Performance Outputs:

Stall Load (lb)	Time to move Travel Distance when unloaded (sec)	Linear Free Speed (in/sec)	Linear Free Speed (ft/sec)
1720.51	2.01	5.97	0.50

With 300lbs



Driving Gear	Driven Gear	Reduction
1	40	0.025
1	1	1.000
1	1	1.000
1	1	1.000

Overall Gear Reduction	
0.0250	40.0 : 1

Mechanism Physical Chacteristics:

Applied Motor Voltage (V)	Load Torque Lever Arm (in) [Pulley Radius]	Gearbox Efficiency	Travel Distance (in)
12	0.5	80%	12

Mechanism Outputs Under Loading:

Applied Load (lb)	Max Loaded Current Draw (amp)	Time to move Travel Distance when under load (sec)	Loaded Linear Speed (in/sec)	Loaded Linear Speed (ft/sec)
480	39.05	2.47	4.86	0.40

Mechanism Unloaded Performance Outputs:

Stall Load (lb)	Time to move Travel Distance when unloaded (sec)	Linear Free Speed (in/sec)	Linear Free Speed (ft/sec)
1376.41	1.61	7.46	0.62

Using a 40:1 Gear ratio

Gearbox that could do the job: https://www.vexrobotics.com/versaplanetary.html

CIM motor

50:1 ratio, $\frac{1}{2}$ in output. First stage = 10, second stage = 5; climb speed = 2.84 (three robots, 500), 2.72 (three robots, 450), 2.44 (two bots, 300lbs)

40:1 ratio, $\frac{1}{2}$in output, first stage = 4 or 10 second stage = 10 or 4; climb speed = 2.47 seconds (480lbs three robots)

ALSO: We need to find hinge strong enough for vertical robot+winch design

For testing tomorrow:

- Middle Bar no wheel

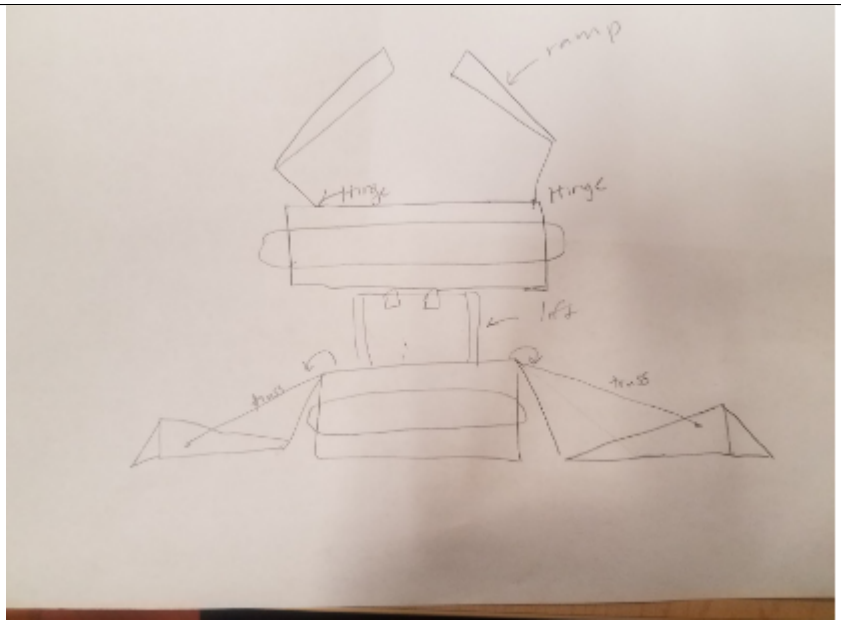
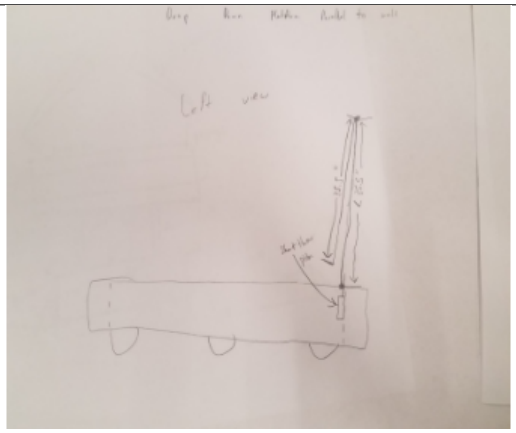
  No weight

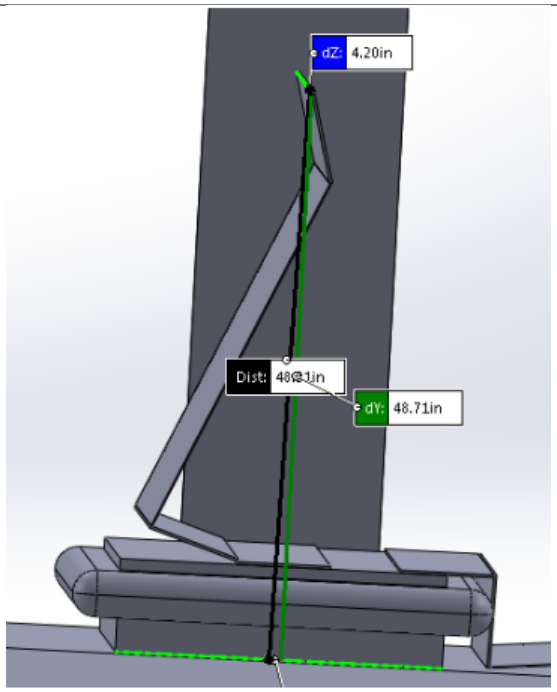
  Weight on one side

Weight on both sides
Vertical no weight
Vertical weight on bottom

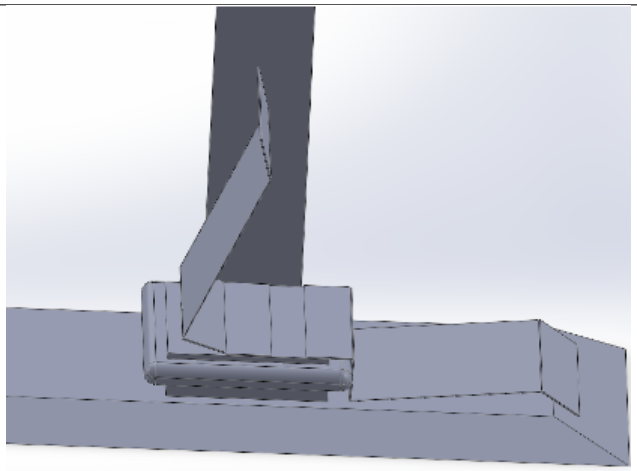
- Front Bar no wheel
  Weight on one side
  Weight on both sides
  Vertical no weight
  Vertical weight on bottom
- Front Bar Wheel
  No weight
  Weight on one side
  Weight on both sides
- Middle Bar wheel
  No wheel
  Weight on one side
  Weight on both sides
- For all that go vertical we have to see if it will go vertical when naturally lifted

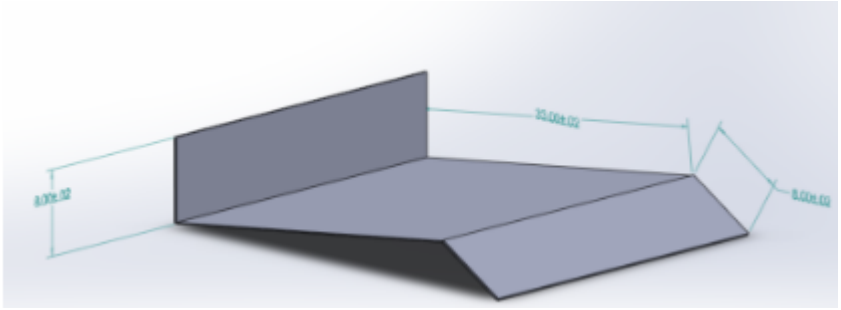
Two designs we want to move forward with

	Two wings deploy at an angle. They allow robots to climb on. The angle would help them stay on
	



Design 1 Simulations:
6in end plates
8in end plates





The wings would slide out and drop.
The dimensions of the wing

Meeting January 11, 2017

- Look into full surface hinges. https://www.tmhardware.com/All-You-Need-to-Know-About-Hinges.html
- Heavy Weight-Ball Bearing (5-knuckle) or Anti-Friction Bearing (3-knuckle)

Meeting January 12, 2018

- David N's findings https://streamable.com/9jaik Video for front bar no wheel

  Front Bar no wheel - distance between both ropes 13 in

  No weight: Robot did not go completely vertical, but was at an angle, say 15 degrees from being straight up

  Weight on one side - robot did become angled but presumably at a sine/cosine rate. During the test, the angle increased, say 10 degrees

  Weight on both sides - robot was more stable but went down say a half inch

  Vertical no weight - clear evidence that robot was not straight up

  Vertical weight on bottom - it angled out much less, say 10 degrees

  Middle Bar no wheel distance between ropes 8 in

  No weight - went relatively straight upwards but due to the bar not being in the exact middle, tilted say 10 degrees from horizontal

  Weight on one side - much easier to tilt it most likely due to the increased distance between applied pressure and point of rotation

  Weight on both sides - robot was more stable but will still tilt of there was a significant difference in pressure

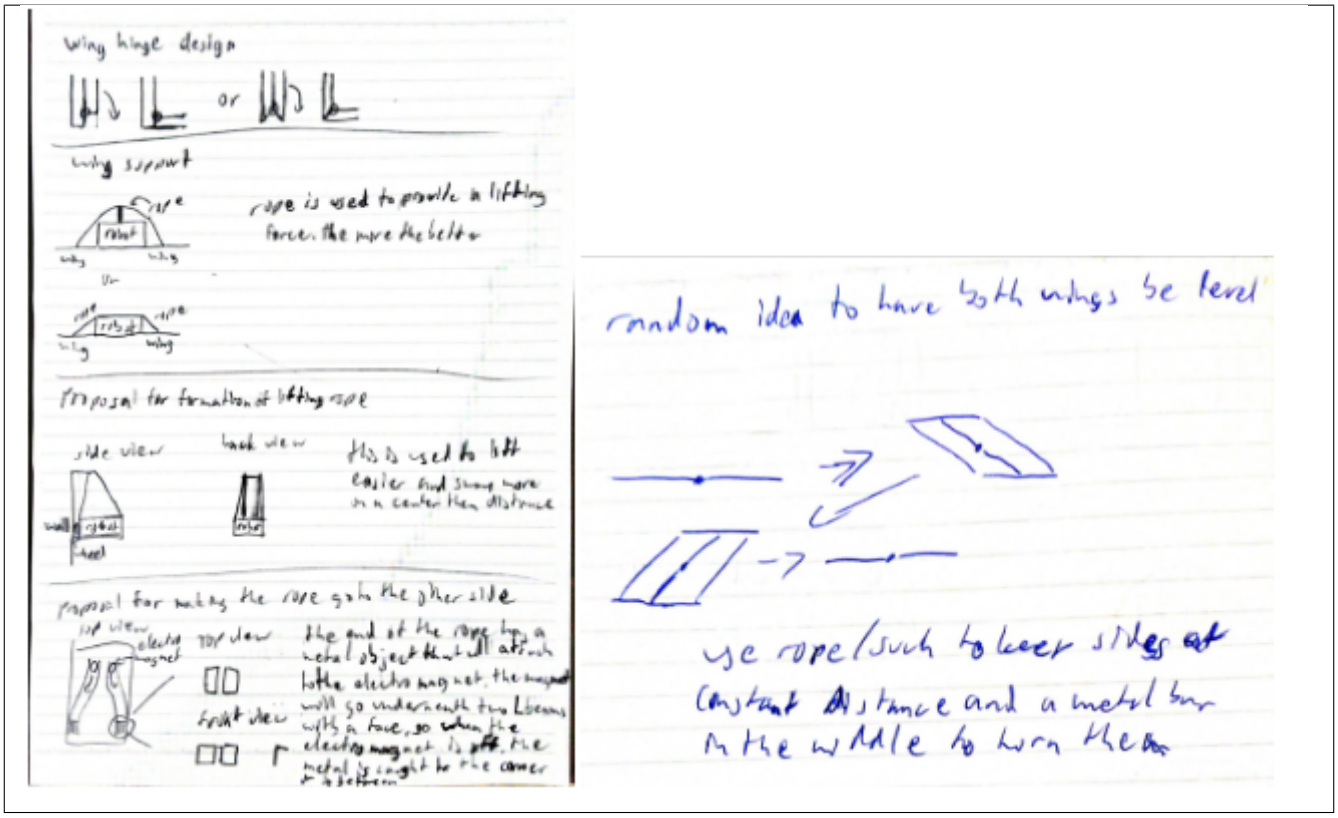
  Vertical no weight - no data

  Vertical weight on bottom - no data

- David N's hypothesis/theories/ideas

  If there is a weight difference in the sides, there will be tilt. Also, because of the weight, it will be harder for the whole thing to sway but we need to be careful if it does. Wheels don't seem to help much in friction so I say we get wheels with more friction. Due to the tilt there needs to be something that can counteract that tilt. One way could be to have that motor on the point of rotation to increase the distance puled to make up for the other less tense string. Also, if the cart to sway, would it be better for the robot to move via distance or angle?

David N's proposals for designs

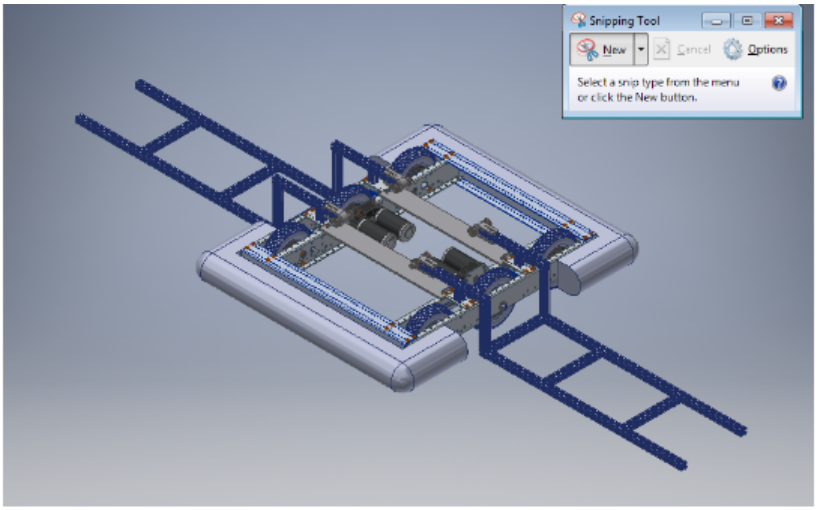


Meeting January 14, 2018

Product	Cost	Link
Steel Bars plate	$ 0.00	N/A
Versaplanetary Gearbox (two stages)	$56.97	https://www.vexrobotics.com/versaplanetary.html
1in flat truck ties	$12.98	http://www.uscargocontrol.com/Ratchet-Straps-Tie-Downs/1-Inch-Ratchet-Tie-Down-Straps
Extruded aluminum (300in)	$69.00+	https://8020.net/shop/1010.html
PLA 2.85 mm	$22.99	link

Linear lift
http://www.revrobotics.com/rev-25-1238/
https://www.youtube.com/watch?v=Psj4JItCh4c

The wing design in CAD



Notes from Design Review

- Grippy plates, plates to reduce damage to the other robots
- Mechanical stops to keep the robot ramps from falling

Criteria	Design 1 (wings)	Design 2	Weight	Notes
Cost	4	5	5	Cost effective
Starting Volume	2	1	3	Needs to be considered in relation to other manipulators
Time to deploy and climb	10	7	10	In seconds (30 max) lower needed for others to climb us
Structural Strength	6	5	8	Needs to be able to support weight of the robot (150 ish pounds) plus possible weight of other bots
Weight	2	4	5	in lbs
Position on the bar	n/a	n/a		Where the bot will grab/how much is left for other bots
Space on the bar	n/a	n/a	4	At least have one other team in mind
Total	24	22	36	

Letting Others Hang

Criteria	Design 1 (wings)	Design 2	Weight	Notes
Amount of Bots that can Hang	8	6	0,6,8	0 for none, 6 for one, 8 for two
Does it prevent us from hanging?	no	yes	yes/no	If yes then levitate must be used
Subtotal	8	6	26	
Total	32	28		

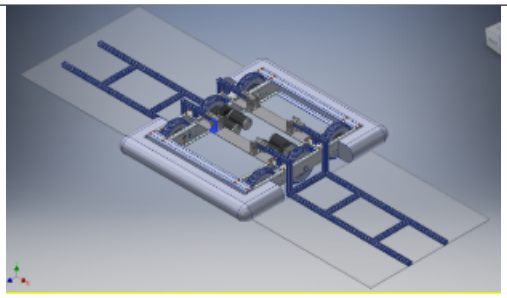
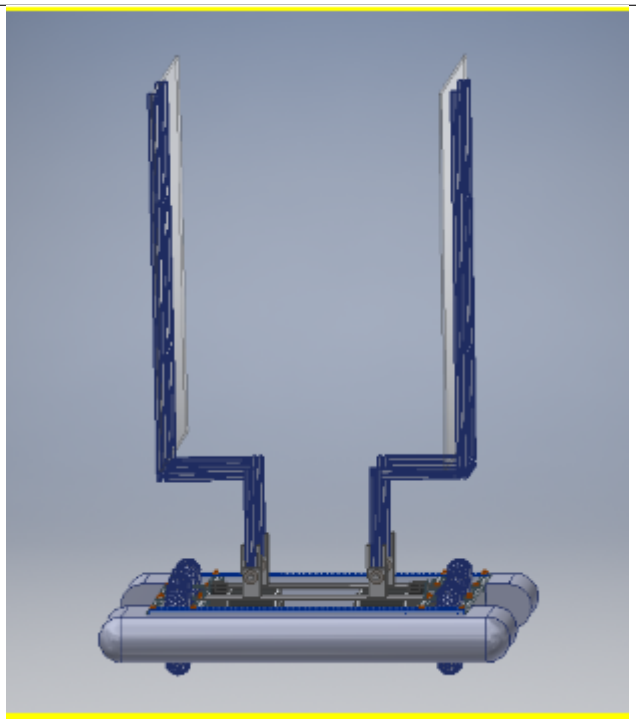
WINNING DESIGN: DESIGN 1

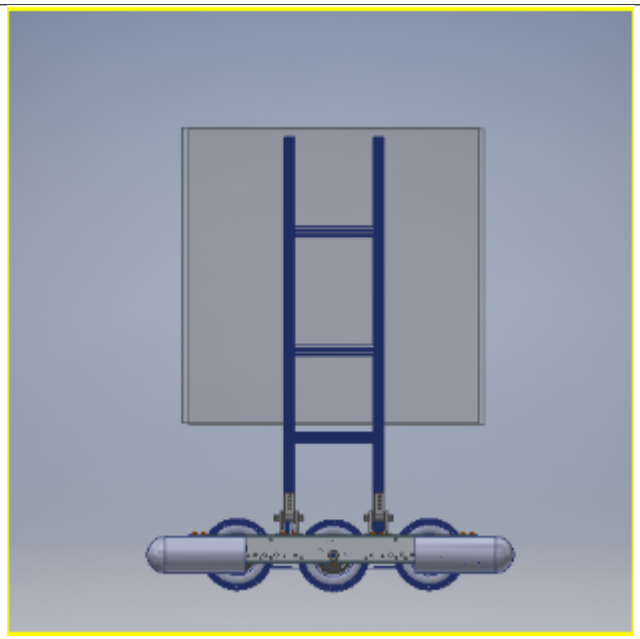
Meeting January 16, 2018

Goals:

- Continue CAD design of the wings
- Order the gearboxes

Outcomes:

	The wings fully deployed with 33 by 33in by 1/4in polycarbonate plates to support the robot wheels
	The wings in their start position, they will drop down when they are



Side view of the upright wings.

Meeting January 17, 2018

The Wings- maybe not 8020?
C-channel:
Pros:

- Lower to the ground
- Thinner

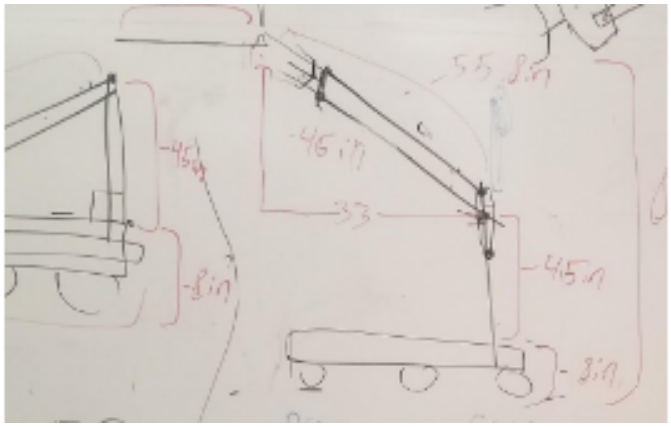
Cons:

- We don't have it already
- The weight was not a significant difference (they are both about 8 lbs of weight for 190inches of aluminum

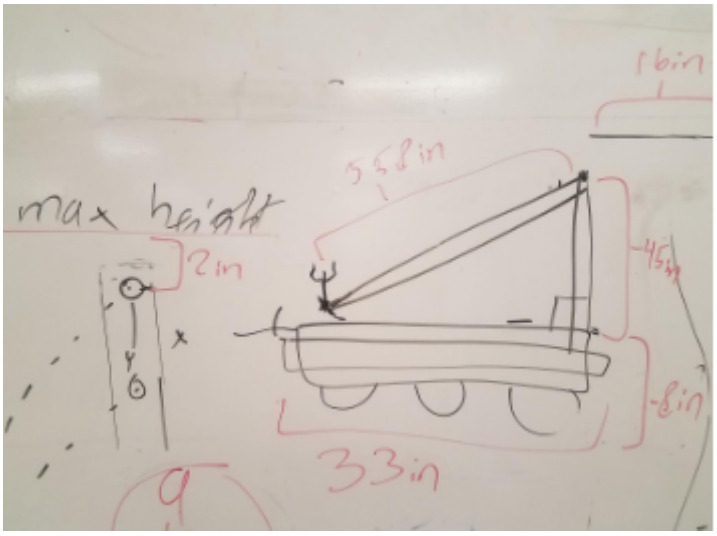
Overall advantage: negligible
New strategy means no linear lift: need to come up with new hook deploy mechanism. David's two bar arm?

Two bar arm:

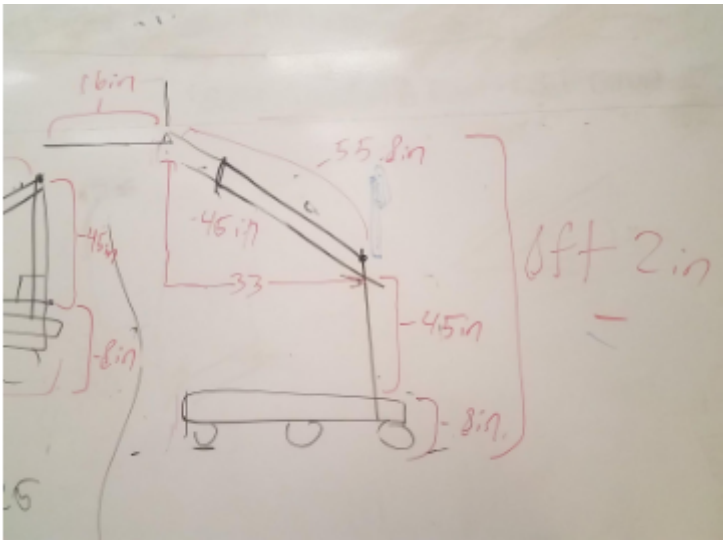
8ft 2in when extended

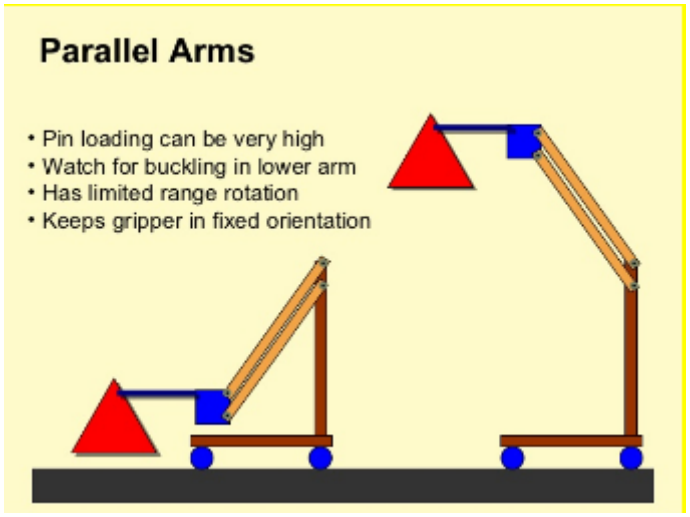


(cleaner picture)



Side view of the upright wings.

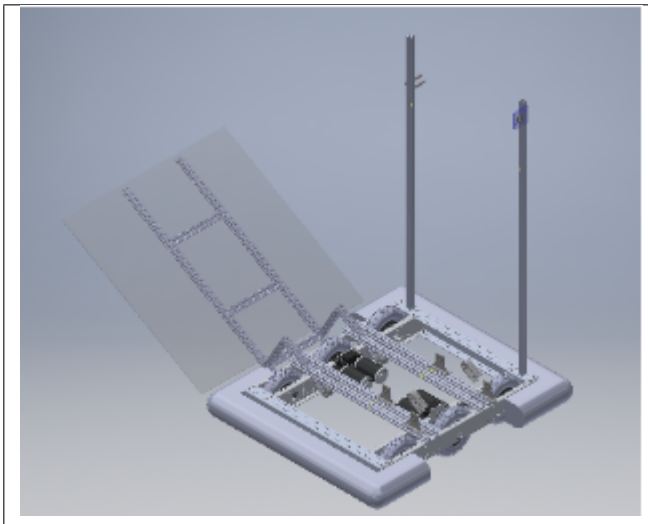




Meeting January 18, 2018

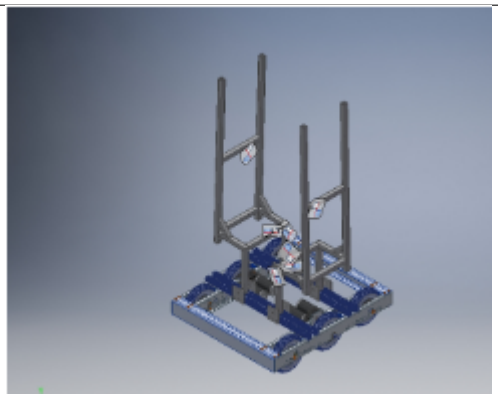
Want to flip hooks up How? Perhaps long pieces of pvc with our hooks that get flipped up?

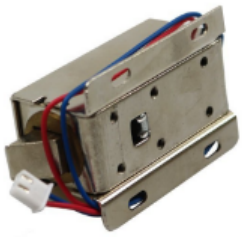
Meeting January 19, 2018

	ReCADed assembly with changed parts and different bars (8020) Here it is roughly. **Plan for sunday:** Work on winch in CAD Test z shape with brackets for wings

Meeting January 21, 2018

- 80/20 was .5 lb/ft
- Steel C-Channel 2x1x3/16 was 2.5 lb/ft

	We changed the steel plates to be extruded aluminum spaced one inch apart on our robot. We also adjusted our brackets to fit this new constraint and make them easier to cut.
	Latching System to let the wings deploy, with an electromagnet https://tinyurl.com/y9kkpj6k

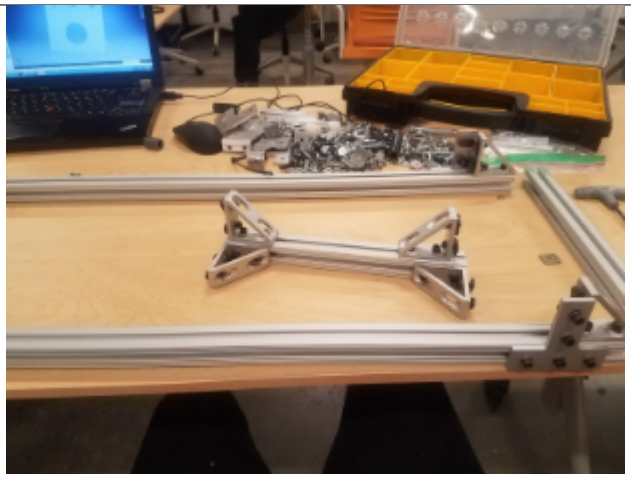
	Door lock latching solenoid https://tinyurl.com/y9kkpj6k
	140lbs | 10 $\frac{7}{8}$ | 8 $\frac{1}{4}$

Meeting January 22, 2018

Goals:

- Start assembling the wings.
- Continue getting the mill ready to cut brackets.

Work:

	We began building the wings tonight. We did one cross bar and super reinforced joints on the corners.

	After putting it against the bot, we realized the 2" by 2" bracket was too big fit under the robot by a hair. We need to readjust those parts. The spacing of the bars is perfect though.
	We ended up finishing one complete wing today. We will finish a second one tomorrow and start making brackets to be the hinges. We will also mount the bars across the chassis.
	The first wing prototype!

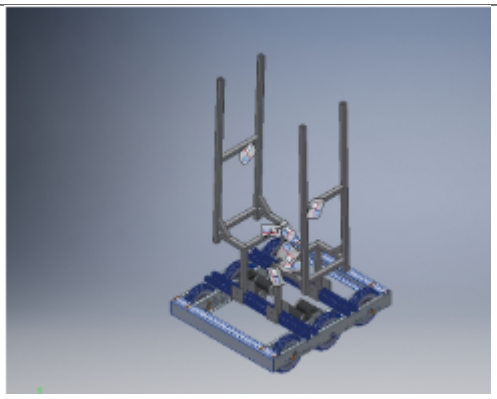
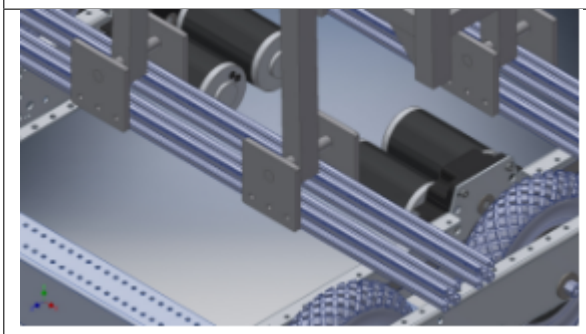
Meeting January 23, 2018

Goals:

- Continue to build the wings
- Test their strength

Work:
We realized that the 8020 wings would be very heavy, especially with all the brackets. The 8020 alone would weigh about 6lbs/wing (.4 lbs /ft). The $\frac{1}{4}$" Lexan is speculated to weigh about 12lbs PER PLATE. THIS IS TOO HEAVY. So, we looked into exploring

other options.
To make the frame lighter:

	We found someone who said they would be able to weld our frame for us. This almost completely eliminates the need for brackets and the metal itself is a third of the weight. ($\frac{1}{16}$" box aluminum is .4lbs/meter!) We reCADed the design to get exact dimensions.
	If we switch to box aluminum, we would no longer need brackets to attach to the hex shaft. We would switch to circular shaft and just drill circular holes.

		The frame supported a significant amount of weight, but trusses on the other angle, might be helpful. We also need to support between the two legs at the top angle because it was bending inward at the top. We reCADed the design to get exact dimensions.

Meeting January 24, 2018

Goals:

- Finalize the designs for the wings
- Start cutting aluminum for the wings
- Figure out how to reinforce the joints

Work:

- We cut the metal for one of the four wings. We defined our measurements.
- We added ribs to the frame of the wings to reinforce the polycarbonate (or wood if we decide to head that route)
- We finished the CAD model
- We decided to reinforce the joints with aluminum inserts and 1 inch bushings where the holes are.

	Cutting the metal for the wings

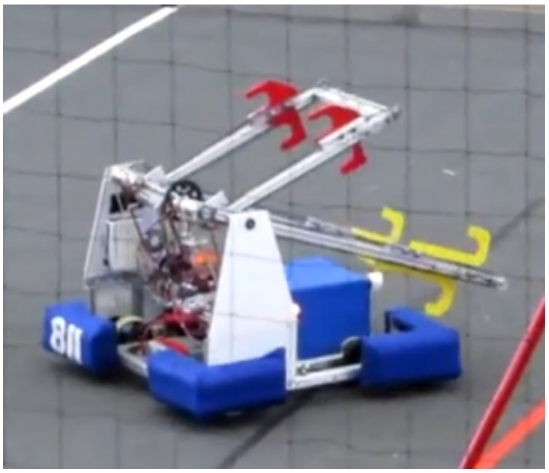
Meeting January 25, 2018

- We cut the metal for wing 2 (We need to buy more $\frac{1}{16}$ the box aluminum to do the other ones)
- We started numbering the assembly for Mr. Taylor

(drawing later in the binder)

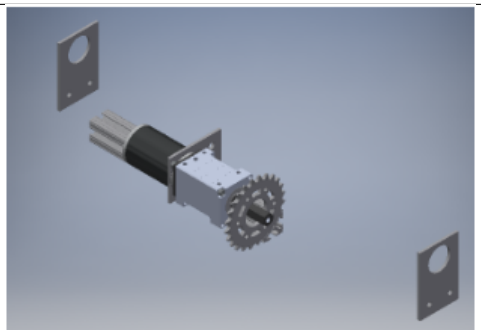
Meeting January 28, 2018

- Climbing Hook and winch system cadded
- Integrated cad model includes linear slide and winch system but no ropes or hooks yet



Meeting January 30, 2018

- the wings were sent out to be welded (one set anyway)
- We worked on integrating the winch in CAD
- We ordered sprockets (28 tooth and 14 tooth) for our indirect drive

	This is our winch without the second bar. We want to gear it so that it is 2 to 1 and we go down to 100 :1 instead of 50:1.

Linear Motion Gearing Design Calculations

Motor Specs

Spec Voltage (V)	Free Speed (RPM)	Stall Torque (N*m)	Stall Current (Amp)	Free Current (Amp)
12	5700	2.43	133	2.7

Mechanism Gearing:

Driving Gear	Driven Gear	Reduction
1	50	0.020
1	2	0.500
1	1	1.000
1	1	1.000

Overall Gear Reduction	
0.0100	100.0 : 1

Mechanism Physical Characteristics:

Applied Motor Voltage (V)	Load Torque Lever Arm (in) [Pulley Radius]	Gearbox Efficiency	Travel Distance (in)
12	0.5	80%	12

Mechanism Outputs Under Loading:

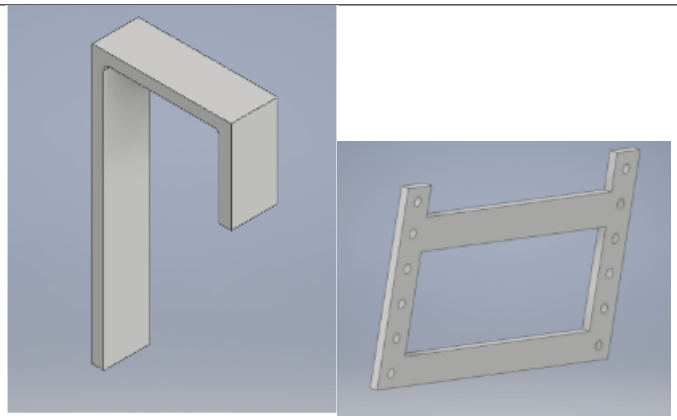
Applied Load (lb)	Max Loaded Current Draw (amp)	Time to move Travel Distance when under load (sec)	Loaded Linear Speed (in/sec)	Loaded Linear Speed (ft/sec)
500	17.85	4.71	2.55	0.21

Mechanism Unloaded Performance Outputs:

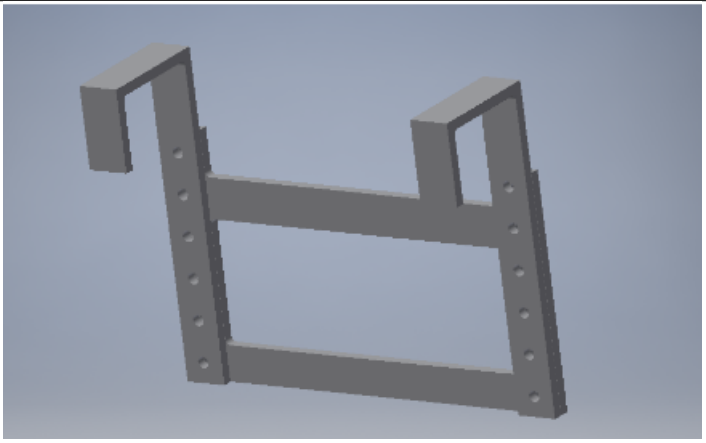
Stall Load (lb)	Time to move Travel Distance when unloaded (sec)	Linear Free Speed (in/sec)	Linear Free Speed (ft/sec)
3441.03	4.02	2.98	0.25

By increasing the gear ratio with a sprocket system, we reduce the amount of current drawn. Also, because it not done with the two stages of the planetary gearbox, and instead in three, we eliminate the concerns of the load ratings on the versaplanetary gearboxes.

Meeting January 31, 2018



The hook and hook plate designs for our climber.



Our finished assembly for the hook mechanism.

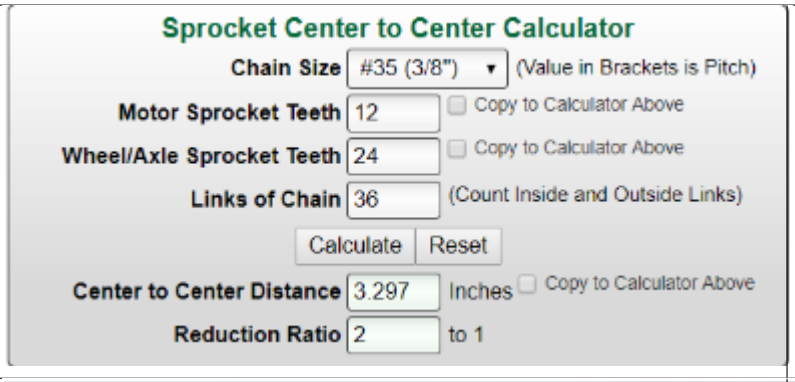
Meeting February 1, 2018

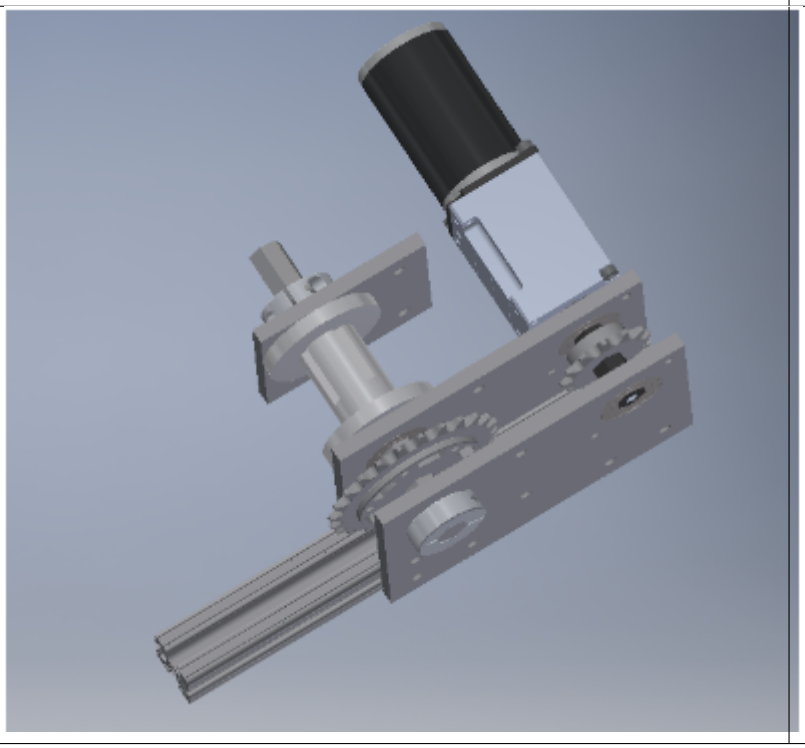
- Our finished assembly for the hook mechanism.

Meeting February 2, 2018

- We worked on integration in CAD of the winch and the rest of the robot

Meeting February 4, 2018





a smaller and more compact gearbox was designed

Meeting February 8, 2018

- We discussed how and where we are mounting the gearbox. The pulley is going in between the wings and the motor will be closer to the center of the robot.

Next Meeting:

- We need to find a better latch mechanism
- We need to place the winch on the bot. Perhaps we can test? We also need to add whatever stabilizing bars we want to have
- If we have the metal, we can finish marking and cutting the second pair of wings

Meeting February 9, 2018

- We designed a spool for the climber

Next Meeting:

- We need to make a drawing of the pulley so it can be machined
- We need to (hopefully) attach the wings
- We need to either make the plates for the wings or send them to be machined elsewhere
- We need to get the hooks settled

Meeting February 10, 2018

- Caded plate to be machined
- Electrical had the bot for most of the meeting

Next Meeting:

- Test stuff and drawing for plate needs to be made
- Spools need to be sent out

Meeting February 11, 2018

- We finalized the hook designs
- Electrical had the bot for most of the meeting

Meeting February 13, 2018

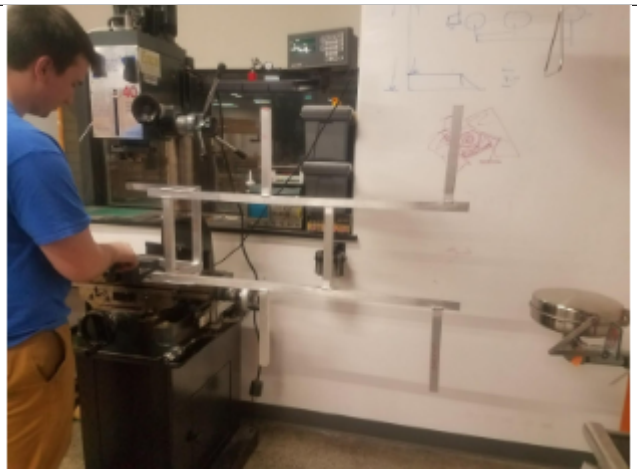
- We worked on building the winch
- Jackson made some of the brackets we need for our wings

Meeting February 14, 2018

- We got the hook and plate drawings to Jackson

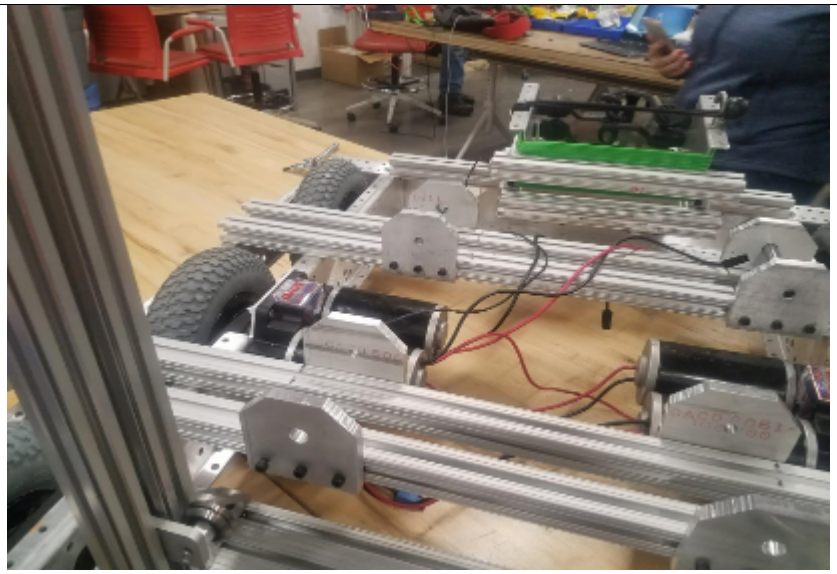
Next Meeting:

- The wings will be here today. We need to attach them to either robot and see how they work. We need to test putting 150 lbs on each one.
- I don't know if the spool will be here today but if so, we need to build that winch and test it
- We need to figure out the ratchet device. I can't remember if we ended up buying those ratchet mechanisms for the gearboxes
- We need to figure out a latching mechanism for the wings.

	Drilling holes in the wings to mount them.

Meeting February 15, 2018

- We attached the wings to the test bot
- We continued building the winch



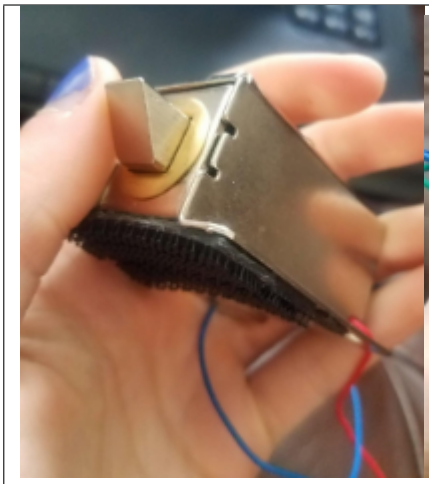
Here is the set-up for attaching the wings. We decided to use shoulder bolts as our hinges. One side of the brackets are threaded, the other is a hole for the shoulder. The wings have a hole to just swing down freely.

Meeting February 16, 2018

- We tested one latch mechanism

Next Meeting

- Hook design
- Winch assembly



We ordered two types of electric solenoids. The smaller ones did not have enough power to do the job. The second one is much bigger, but also much stronger.

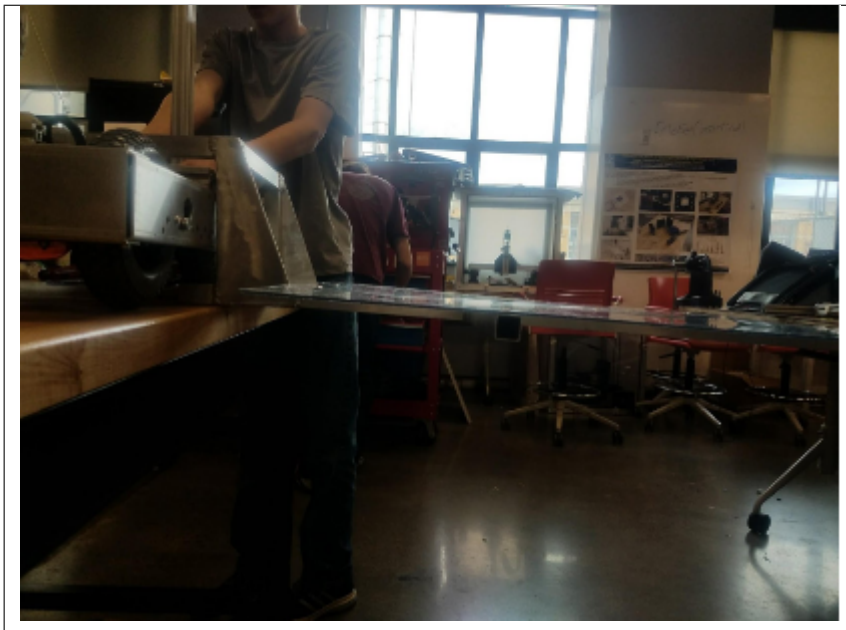
Meeting February 17, 2018

- We riveted the lexan to one of the wings
- We partially assembled the winch system
- Jackson milled some of the parts we needed for the winch

The black lexan makes it hard to see the robot. It is super epic though so hopefully we can keep it. With the lexan, the wings weigh just about 15 lbs each. We are concerned the lexan will put us overweight. We might need to switch to a lighter material.

Next Meeting:

- We need to review and mill the hooks
- We need to work on the latch system. Those door locks are pretty good as it turns out, so we need to test them on the wings
- We need to test the winch and the wings!!



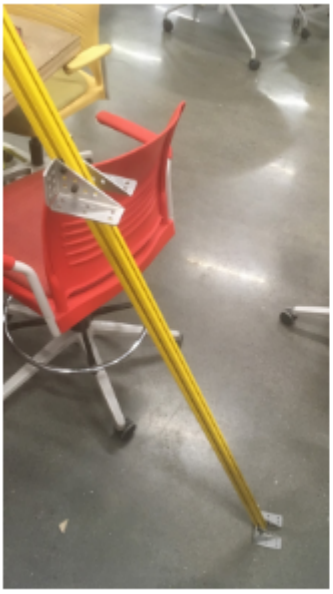
With only the 1/16" box aluminum, the robot experienced a significant amount of deflection. We realized that we would need to stiffen up the bottom bars somehow. To do this we inserted $\frac{3}{4}$" x $\frac{3}{4}$" $\frac{1}{8}$" box aluminum. We welded the inserts into the bottom bars.

Meeting February 18-19, 2018

- we successfully climbed but there are problems with the chain.
- we prototyped the wheels to help climb

Next Meeting:

- test the wheels for climb for realsies
- chop nub off that's hitting wing on slide
- fix winch/ add ratchet
- attach latches for wings

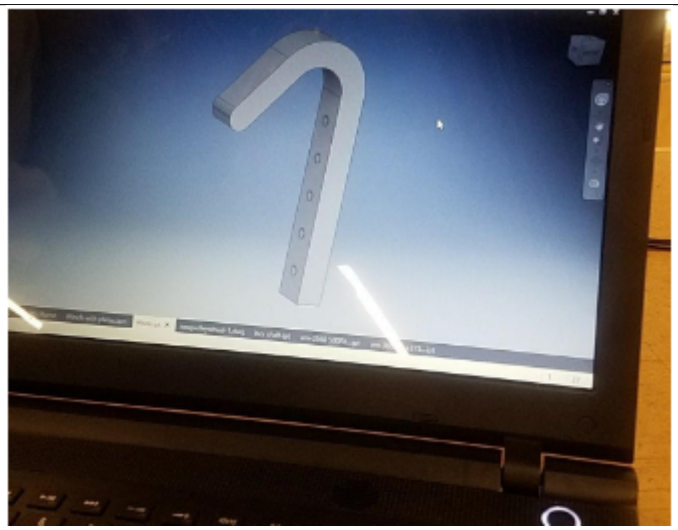


This is the support bar for the scale so when we climb we don't tip too much. Prototype of slide support We originally used a string instead to simulate it.

Meeting February 20, 2018

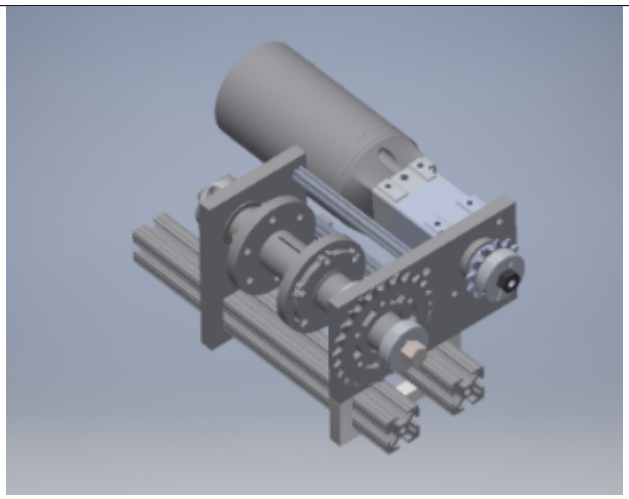
This is the deployment mechanism mounted. We want to instead put them on the inside so they aren't over the electrical board.

Meeting February 25, 2018

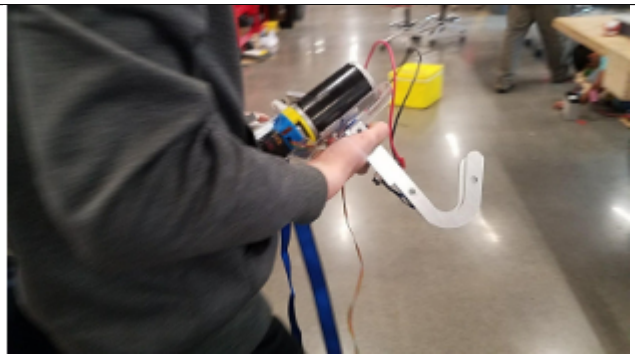
	Redesign of the hooks .

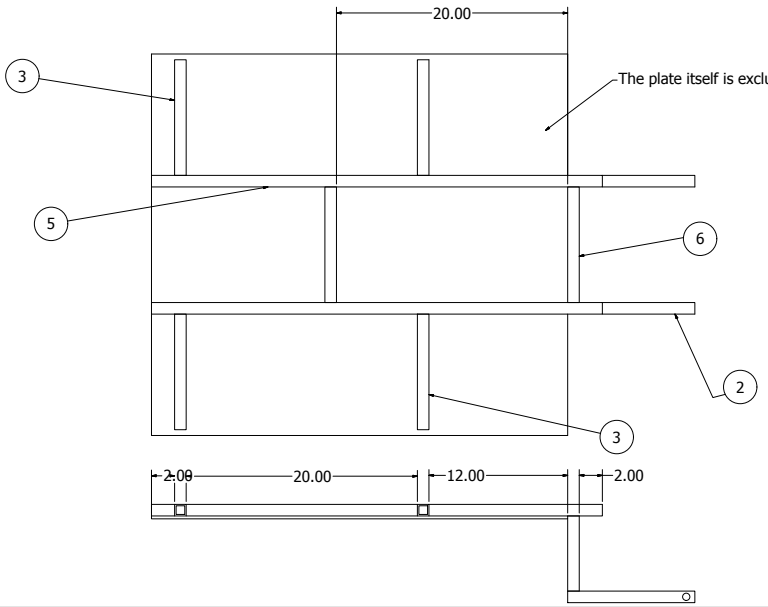
Meeting March 6, 2018

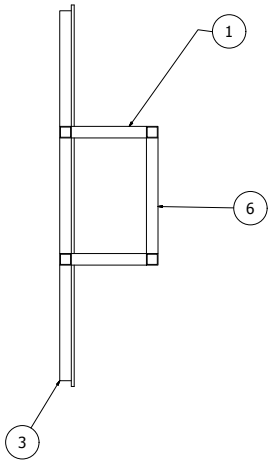
Between stop build and unbag, we spent most of our time focused on the box manipulator. We also spent time fixing the spacing on the plates for the winch so the chain wouldn't be as loose. We also wanted a better way to mount the winch onto the chassis.

	We adjusted the winch so that it mounts more easily to the 8020. We added two 'u' shaped things that screw into the plates.We also fixed the spacing between the sprockets so the chain is tighter.

Meeting March 11, 2018

	Assembled final winch





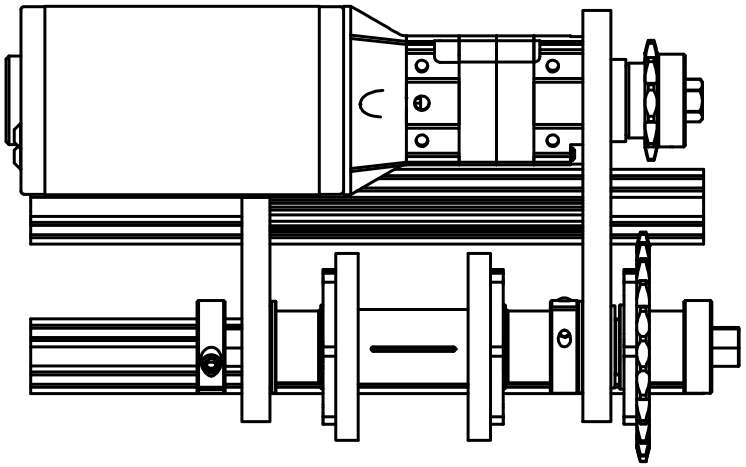
PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	2018007	6.5" box almuminum (1"x 1" x 1/16")
2	2	2018006	11" box almuminum (1"x 1" x 1/16")
3	4	2018008	10" box almuminum (1"x 1" x 1/16")
4	1	wingplates	lexan plate (excluded)
5	2	2018005	39" box almuminum (1"x 1" x 1/16")
6	3	2018009	10" box almuminum (1"x 1" x 1/16")

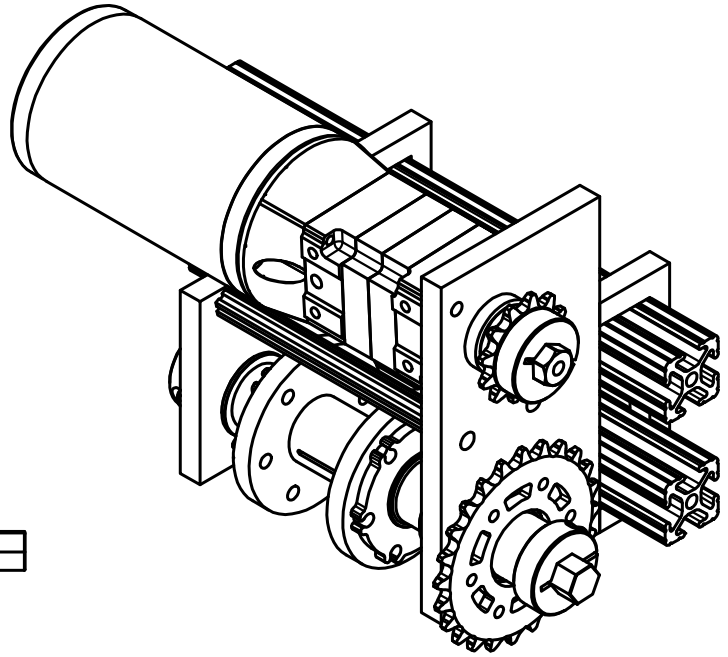
DRAWN	Emily	1/29/2018
CHECKED		
QA		
MFG		
APPROVED		

TITLE

SIZE D | DWG NO boxaluminumwing-1 | REV

SCALE 1/4 | SHEET 1 OF 1





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CHECKED				
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MFG		Winch		
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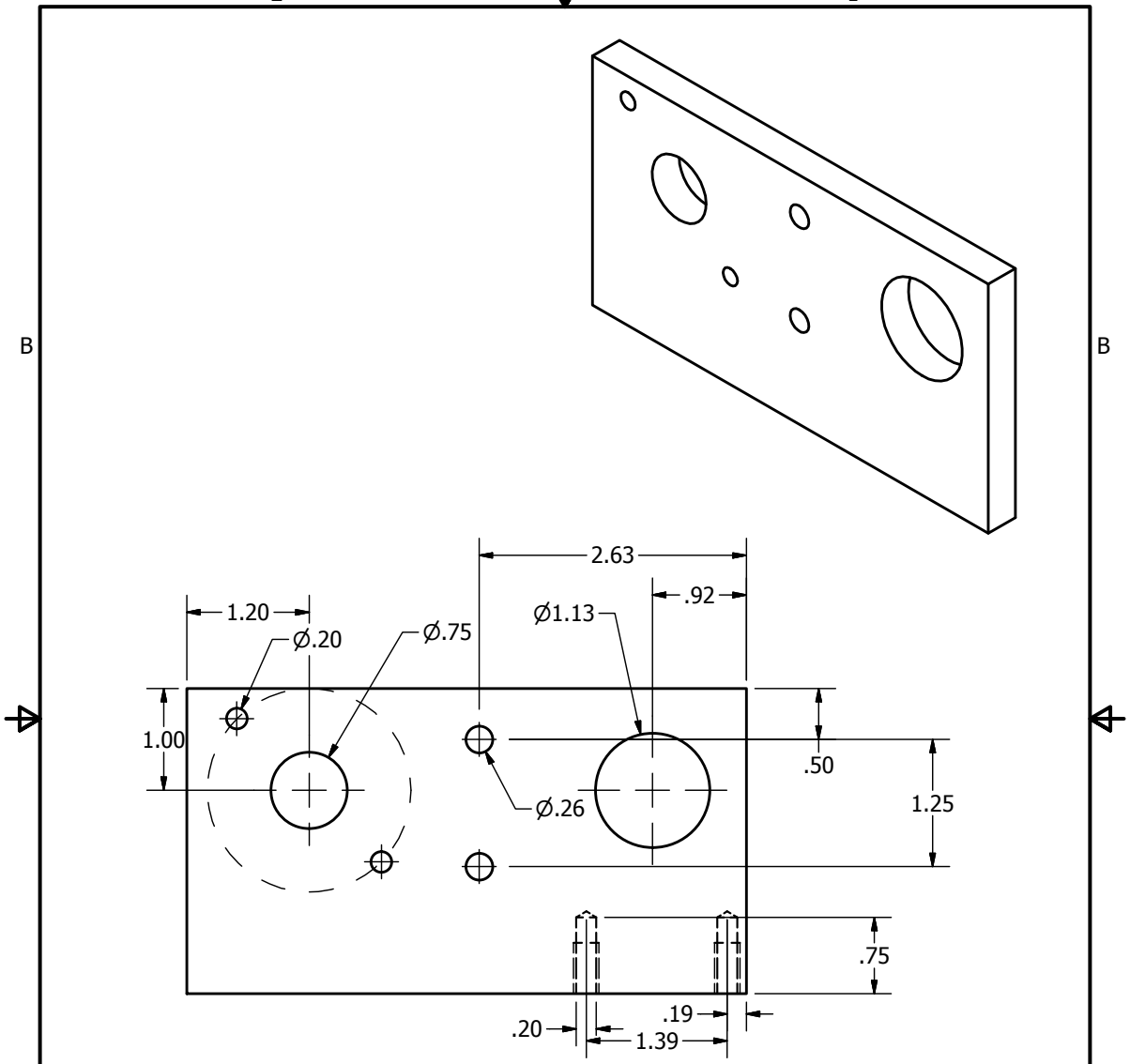

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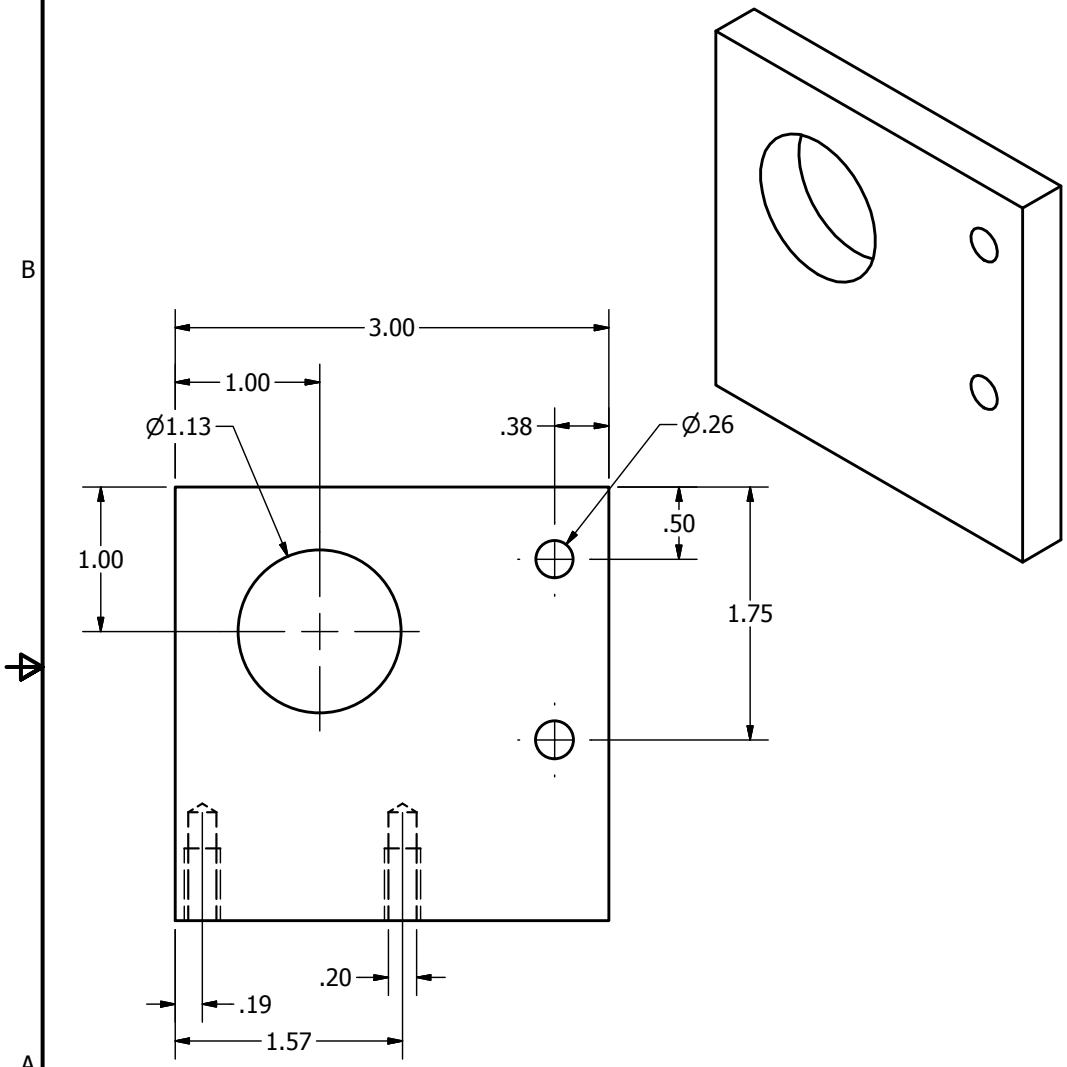

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QA		TITLE
MFG		
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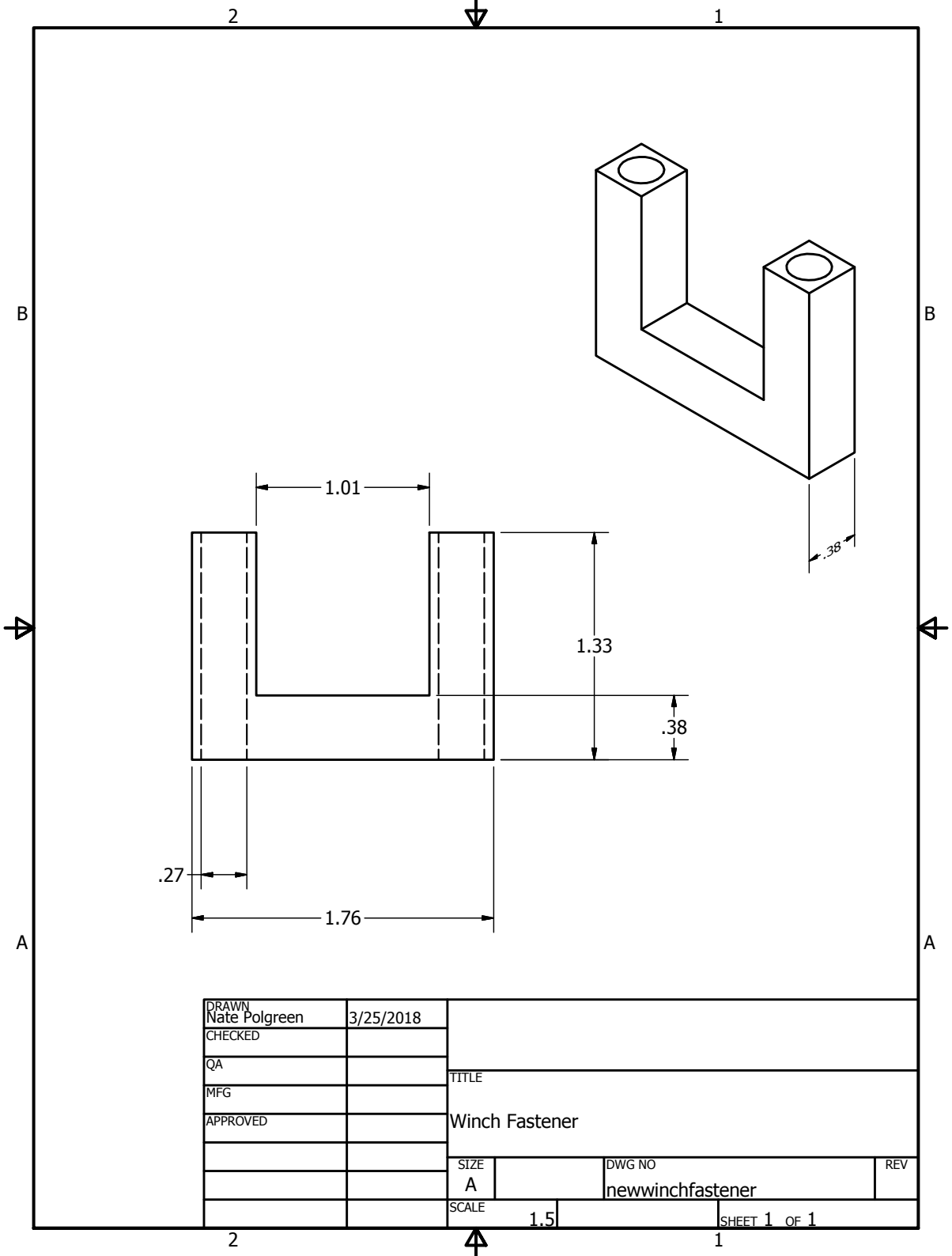
		SCALE 1 : 1 / SHEET 1 OF 1



DRAWN Nate Polgreen	3/25/2018	
CHECKED		
QA		TITLE
MFG		
APPROVED		Winch Fastener
		SIZE A / DWG NO newwinchfastener / REV
		SCALE 1.5 / SHEET 1 OF 1

Electrical

Meeting January 23, 2018

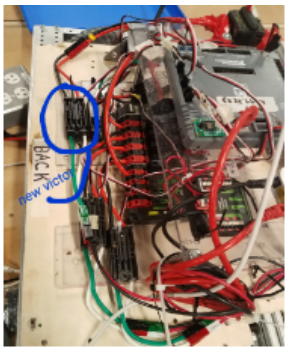
We were able to fix the robot signal light as it was previously not turning on. The problem was that the connections were making contact with each other, shorting the light out. We also started making a test board for the electronics on Robot 1.

Meeting January 29, 2018

We started exact measurements and layout of electrical board and began to CAD it. We decided upon the RoboRio and PDP location. The router and voltage switch location are still to be determined as they will not be on the board and instead on an accessible location elsewhere in the robot.

Meeting January 30, 2018

We wired the block manipulator onto the board and tested it. It works perfectly. Dave from software showed us that some of our batteries have exposed or loose connections, so that's needs fixing. We started drafting our final electronic board, we need to check if it matches the CAD model and finish making it. We also need another Victor onto the robot for the final draft. For the block manipulator test that we currently have, we spliced a wire and uses one controller. That is illegal and we have to use another controller in the future.



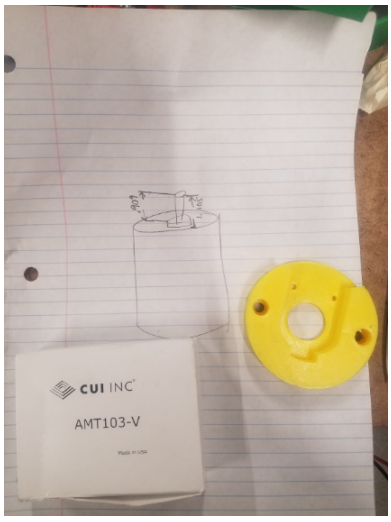
Meeting January 31, 2018

We started to get a good layout of the final board and component placement

Meeting February 7, 2018

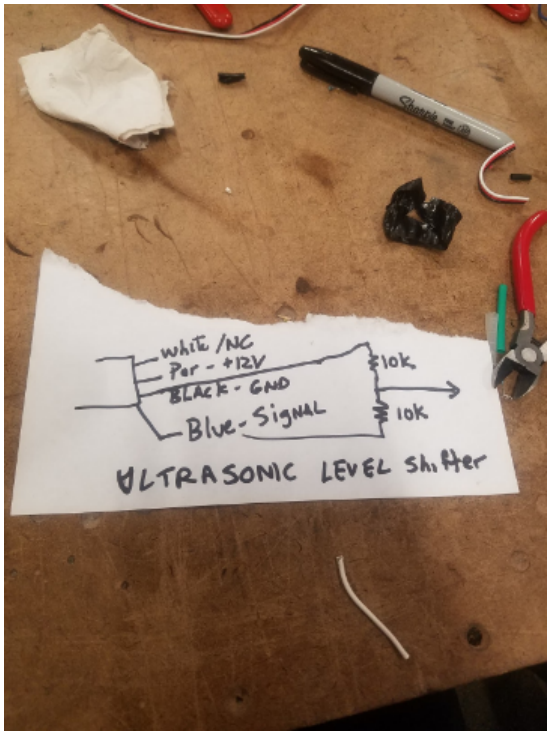
We are going to mount the Victors and Talons upside down on the horizontal bars on the robot. However, we are held back by the fact that we lack specific T-Nut sizes, we should make some next meeting. We want to have at least one robot done by Sunday.

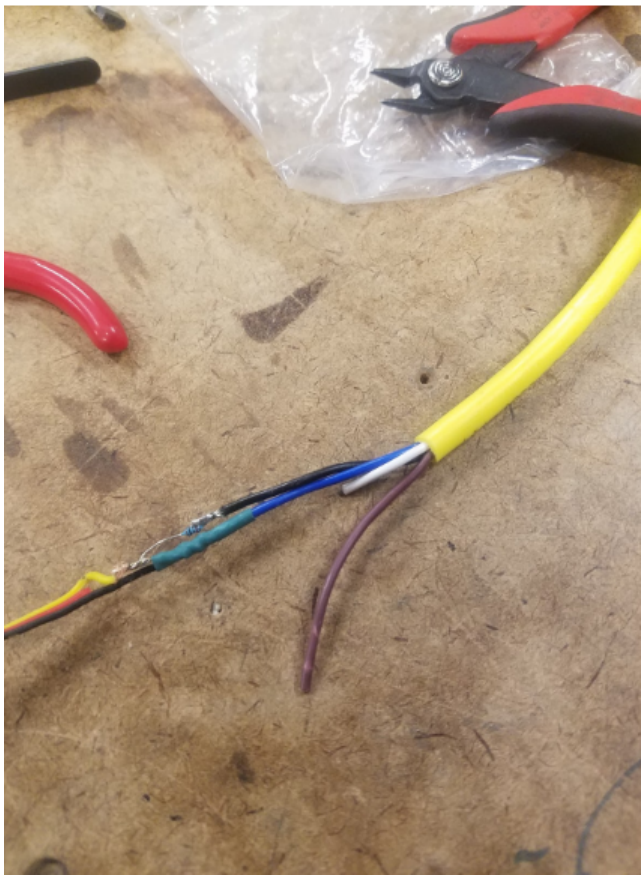
Meeting February 15, 2018



Meeting February 17, 2018

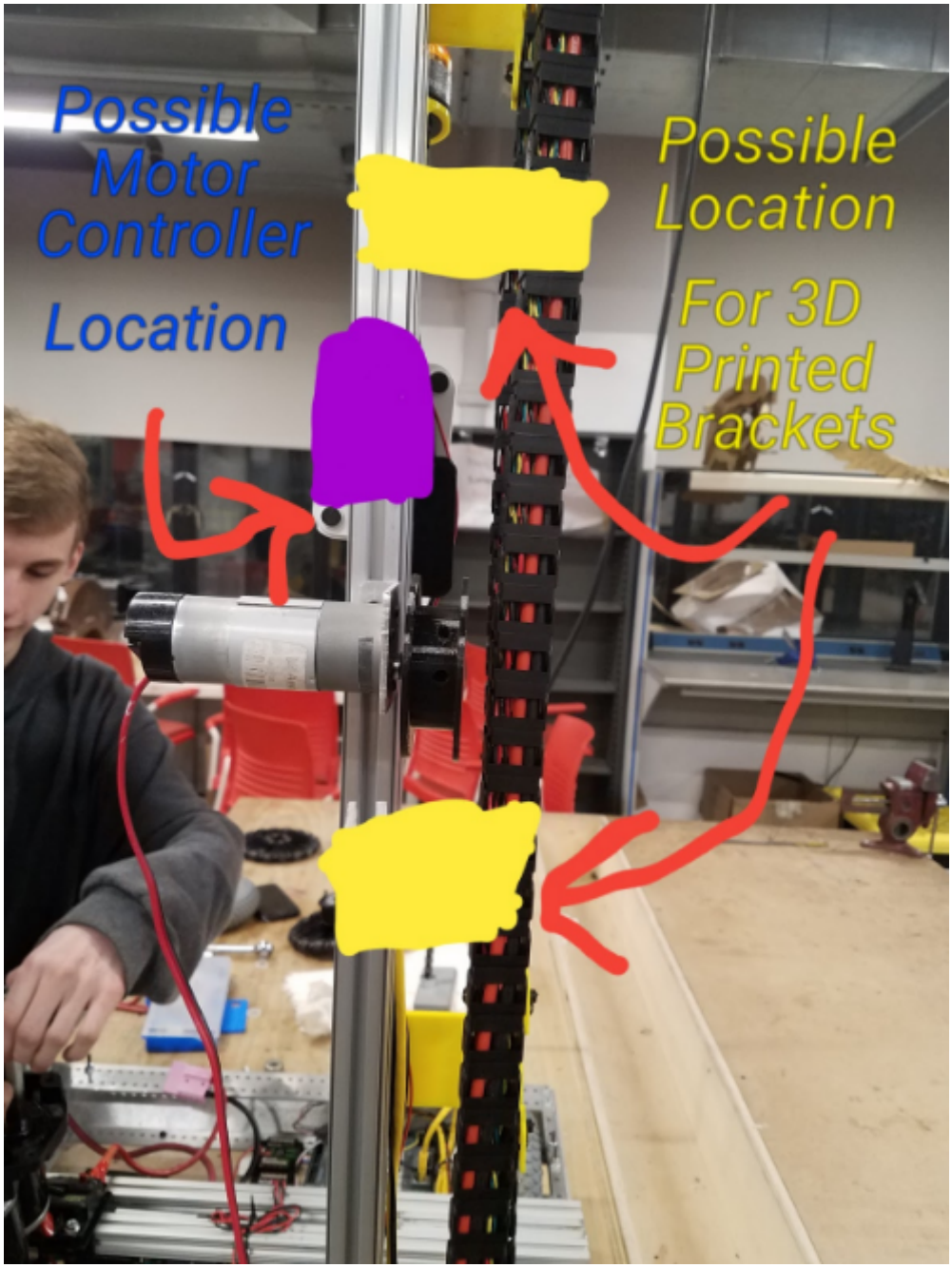
Meeting February 20, 2018





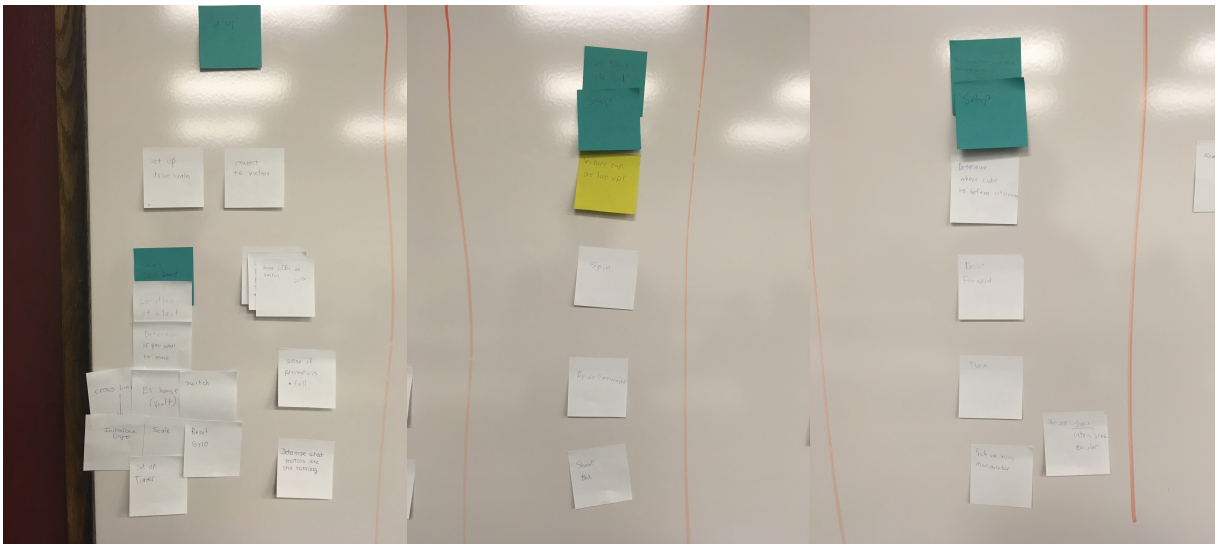
Meeting March 20, 2018

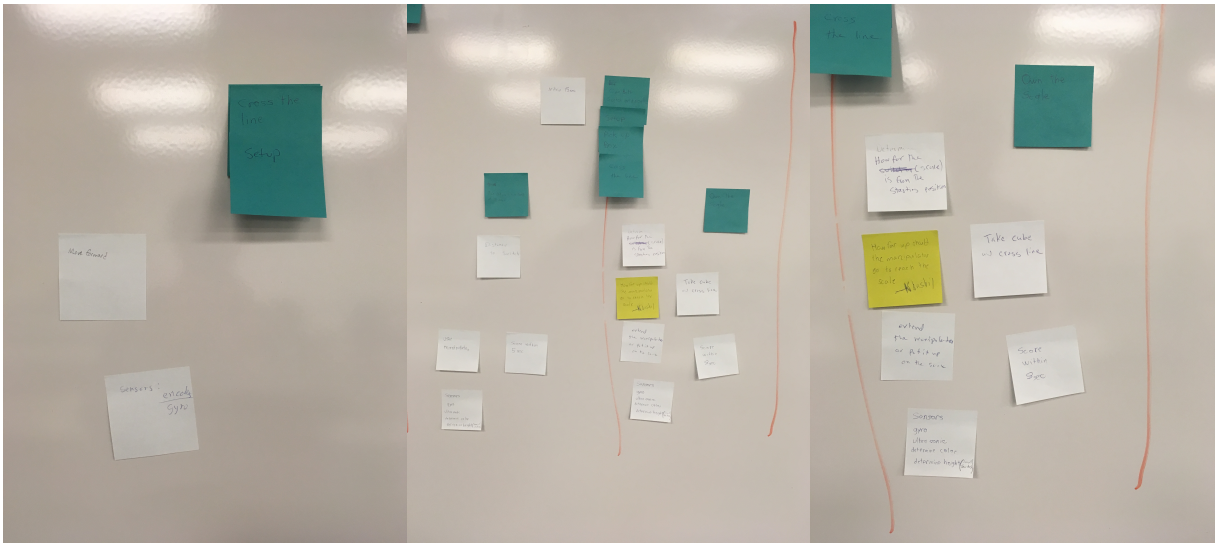
We brainstormed possible locations for brackets and the motor controller for the moving wires.



Software

Software Scrum




Cross the line
Setup
Take cube across line
Scan the Scale

Subsystem

Autonomous

- Encoder to check rotations
- Either a long/short range ultrasonic to determine if we are approaching something

Box Intake

- 2 Motors running
- 1 Trigger to suck in
- 1 Trigger to suck out
- No sensors needed initially

Lift

- Use an encoder to see how high we are

Wing Deploy

- Use the pneumatic controller to control switch on/off

Climbing

- Somehow use a winch?

Strategizing

Seconds	Nothing	Cross the Line	Switch	Scale
0	0	0	0	0
1	0	5	2	2
2	0	5	4	4
3	0	5	6	6
4	0	5	8	8
5	0	5	10	10
6	0	5	12	12
7	0	5	14	14
8	0	5	16	16
9	0	5	18	18
10	0	5	20	20
11	0	5	22	22
12	0	5	24	24
13	0	5	26	26
14	0	5	28	28
15	0	5	30	30

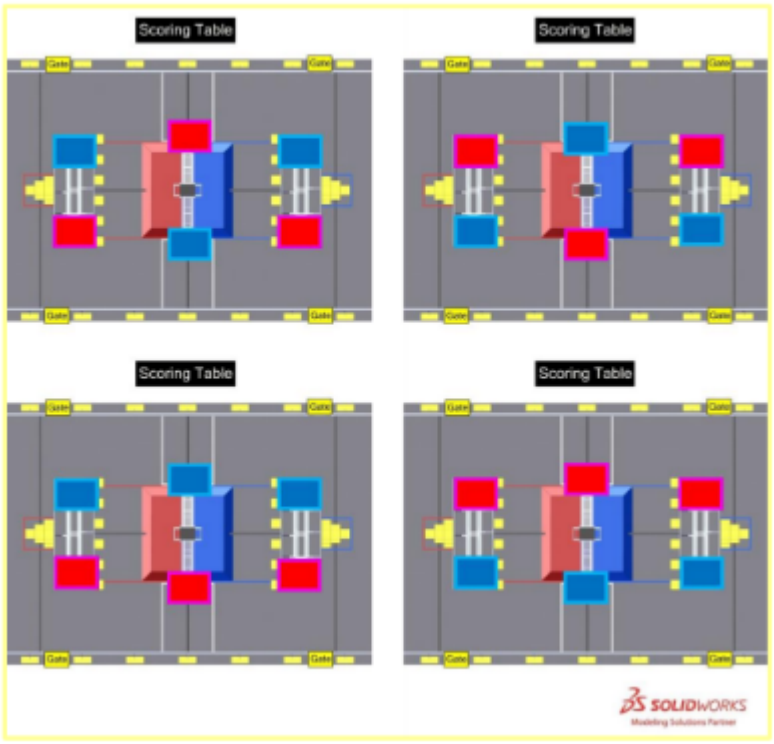
Switch		Scale			Vault	
When did it score?	4.5	When did it score?	0		True or False	TRUE
Possible Points Earned	31	Possible Points Earned	40			

Switch and Scale		Cross the Line	
When did it score?	0	When did it score?	10
Possible Points Earned	40	Possible Points Earned	5

Autonomous

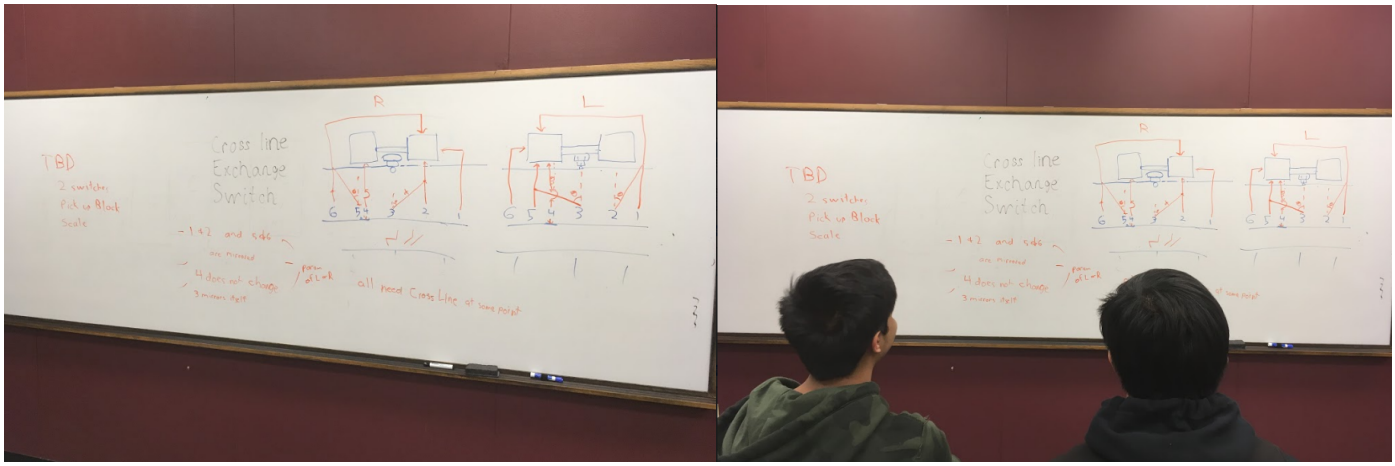
- Location
  - Middle
  - Left
  - Right
- Switch/Scale Position

Figure 4-1 Possible PLATE assignments

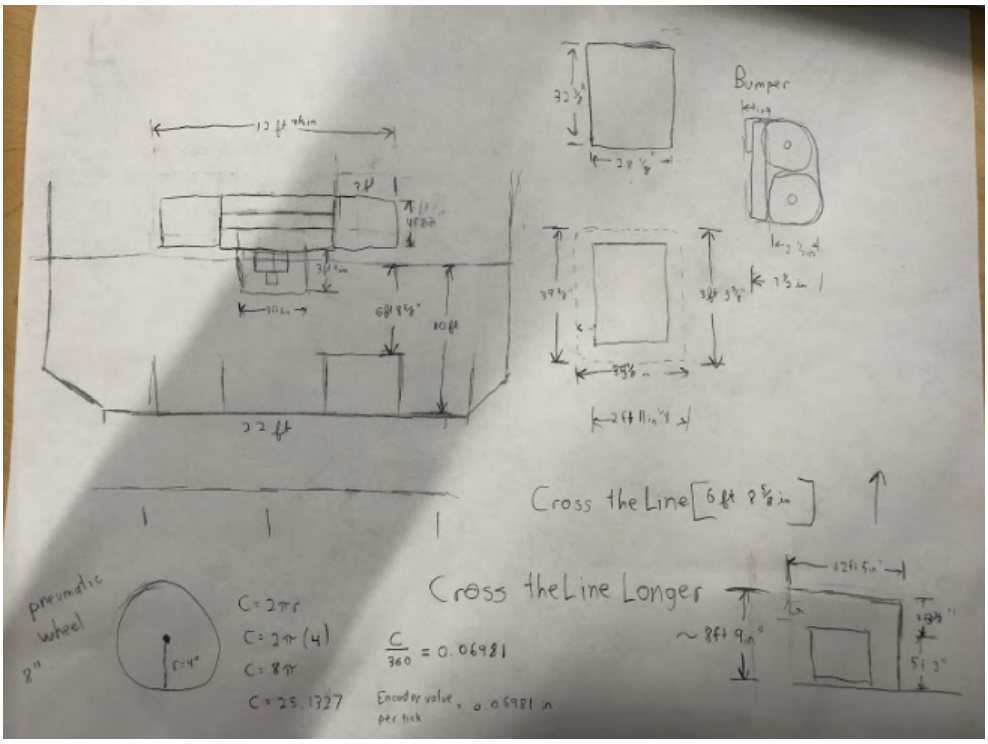


- Cross Line
- Score On Switch
- Score Switch + Pick up Block
- Score Switch twice
- Score in Vault and Cross Line
- Score in Vault and Score Switch

Strategizing



Cross the line dimensions.



Unbag List

- Test to see if both encoders are working on the bot
- Test Intake and Outake manipulator
- Test the Drop intake
- Test the lift motor
- Test the climber motor
- Test to see if drive is the right way
- Check if PID numbers are consistent along both bots
- Have the short range finders mounted at the frontmost part of the bot
- Wire the short range finders correctly

Allen-Bradley Ultrasonic

Catalog Number	Description	Cost	Where to buy?
Bulletin 873M General Purpose Cylindrical 18mm			
873M-D18AV300-D4	Proximity Sensor, Cylindrical 18mm, Analog Voltage (0-10V DC), 18mm Diameter, 50mm to 300mm Sensing Distance, Micro Quick-Disconnect (DC)		
889 Cordsets and Patchcords			
889D-F4AC-5 long cable, 16.5ft	DC Micro (M12), Female, Straight, 4-Pin, PVC Cable, Yellow, Unshielded, IEC Color Coded, No Connector, 5 meter (16.4 feet)		
889D-F4AE-2 short cable, 6.5ft this is what we currently have	DC Micro (M12), Female, Straight, 4-Pin, PVC Cable, Yellow, Unshielded, IEC Color Coded, No Connector, 2 meter (6.56 feet)		

Bumpers

Section 1: Team Number Prep

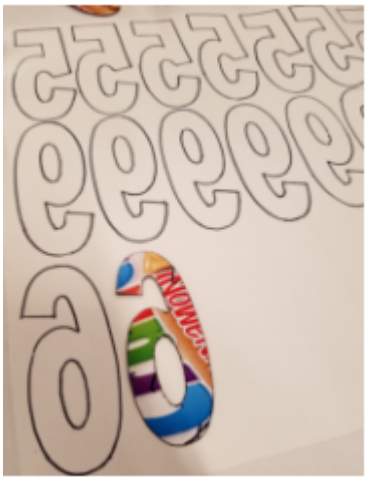
For a set of bumper numbers, you will need:

- 8 sets of team numbers
- 30 inches x 16 inches of thick white fabric duck cloth) and backing (a 15 inch wide roll of backing is best)
- Stencils that follow the game rules for number size and stroke width

Prepare the white fabric.

The best choice for fabric is Duck Cloth which is similar to bumper material and it very sturdy. Iron on dual side backing, like the one pictured below. Make sure to follow instructions on the box.

Trace and cut out the numbers. Make sure you are tracing the numbers backwards since you will be flipping them when you attach them to the bumper fabric



Section 2: Bumper Fabric Prep

For a set of bumpers, you will need:

- 1 pack of blue bumper fabric
- 1 pack of red bumper fabric
- Note that dimensions will depend on your robot and could vary each season

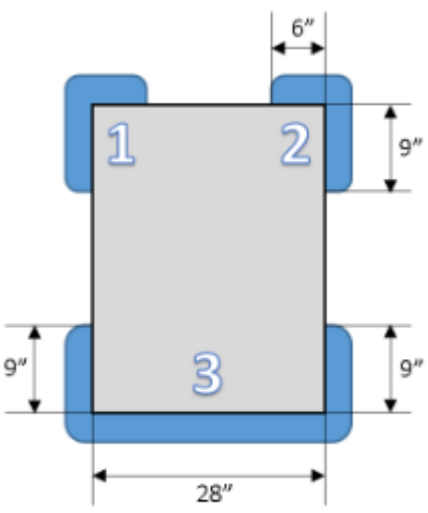
Determine your fabric dimensions.

Measure and record the edges of your robot you want to be protected by bumpers. Make sure to follow the game rules which may vary each season.

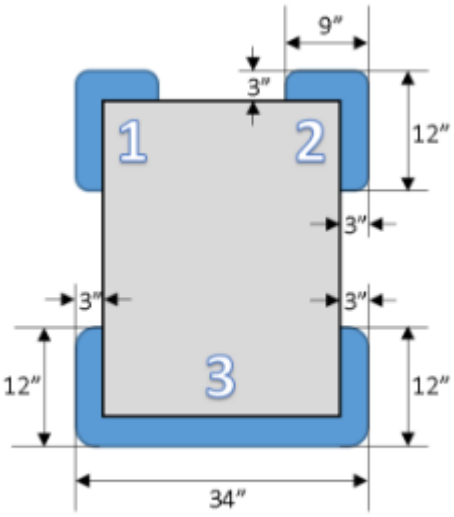
From the dimensions you measured for the edges of your robot, or inside dimensions of your bumpers (also same as the wood length you will need to cut):

- Add 3" to each side to account for the pool noodles, since fabric is wrapped around the outside of the bumpers
- Add 3" to any side of the bumper that opens on an interior of the frame perimeter, leaving the edge of a pool noodle exposed
- Add ¿ 4" of scrap to each bumper edge which will be used on exposed edges of the bumpers as well as used to hold onto later when you need to pull the fabric tight over the bumpers and staple it in place. In this example, 4.5" of scrap is used.

The height of your fabric should be $>$ 16". In this example, 18" tall fabric is used.



Inside bumper measurements



Outside bumper measurements

Measurement	Bumper 1 and 2 (same size)	Bumper 3
Bumper outer dimensions	3"+9"+12"+3"=27"	3"+12"+34"+12"+3"=64"
Additional fabric	2 x 4.5"=9"	2 x 4.5"=9"
Total fabric length	27"+9"=36"	64"+9"=75"

Note that for this example, Bumper 1 and Bumper 2 are the same size.

Cut your fabric to size.
Note that for this example, Bumper 1 and Bumper 2 are the same size.

- Draw guide lines There are a couple critical dimensions that should be drawn out on the bumper fabric prior to any sewing. Use a thin pen or pencil for these guidelines so they are not visible after you have assembled the bumpers.
- Draw guidelines for the velcro on the front of the fabric at 0.5" from the long edge, 5.5" from the edge, and 10.5" from the edge (some bumper fabric very clearly has a "back side" that looks a little like plastic. Guidelines should be drawn on the "finished" side).
- Draw guide lines for the numbers 8" long, 4.5" tall and should be centered on the sections that require the numbers (one number visible on each side of the robot)
  If you are using the bare minimum bumper size (6"), you should try to squeeze the numbers within 7.5" instead of 8".

Section 3: Attach the Team Numbers

- Remove backing and iron on the team numbers into their needed positions

  It is important to note that the red and blue fabric should be mirror images of each other. This ensures that the numbers will be the correct orientation when the fabric is flipped over the bumpers. One way to test this it to line them both up and

"flip" the numbers and make sure they are always right side up. For this example, the top of the red numbers is closest to the 0.5" marked guideline. The top of the blue numbers of closest to the 10.5" marked guideline.

- Sew on the team numbers using white thread

Section 4: Attach the Velcro

- Sew the velcro strips next to the drawn guidelines towards the inside of the fabric. The soft side of the velcro should be sewn on the top edge against the 0.5" guideline, leaving 0.5" of fabric showing. The hook/rough side of the velcro should be sewn against the guideline that is 10.5" from the edge of the fabric. The velcro only needs to extend to guideline that is 3" longer than the outer bumper dimension (leaving 4"-6" of blank fabric on each end).

Section 5: Combine the Bumper Covers

- Lay the matching red and blue bumper covers face down on top of each other, and sew them together along the soft velcro edge. Note that if you sew them 0.25" from the edge, you won't be sewing through the velcro which is best.
- Flip the bumper covers so that they are both facing the outside and fold along the edge you just sewed
- Sew along the center of the soft velcro. This will keep them together as one cover "flap". Note that it is a good idea to use red thread on the red velcro and blue thread on the blue velcro so that it blends in.
- Sew the covers together again along the 5.5" guideline along the whole bumper cover, making sure you also sew through the numbers.
- Your cover is done!