Date: 9/11/18

Duration: 6:00 PM – 8:00 PM

Tuesday, September 11, 2018 Meeting

Students:	Rohan	Patrick	Bryan	Connor	Katy	Jonas	Ian	Paige	Claire

Karthik came to visit to see if he wanted to join the team

Mentors:	Mr. Prettyman	Mr. Szeto	Mr. Buckingham	Tobi

Agenda:

Mechanical Accomplishments:

Programming Chassis	
Problem: Programming Chassis	• Having a chassis early means we can start programming autonomous earlier and there are a lot of points in autonomous

Generate Concepts: List of Drive trains	• Mecanum
	  ◦ Holonomic movement + more reliable odometry
	• All-terrain
	  ◦ The main benefit of tank treads (getting over crater) is not very important
	• Slide drive
	• West Coast
	• Kiwi
	• X Drive
	  ◦ Holonomic movement
	• Tank Treads
	*red were quick removals
	
	Drive train that can get in the crater is not a big problem – it would take too long to go in for harvesting to be a competitive robot in the late season
	
	Overall consensus on Mecanum

Generate Concepts: Mecanum Drive	• Use odometry wheel to track strafing • Pros of Holonomic Drive (Maneuverability)

Hanging	

Problem: Hanging on the Bar	• There is a large amount of points in hanging
	  ○ Landing is 30 points
	  ○ Latching back on is 50 points

- 9/21 - Split Hanging teams into going up and dropping down

Non-Technical/Discussions:

Re-watched the Rover Ruckus video to refresh memory on game rules.

Where is our emphasis?

- "Autonomous can be worth a total of 80 points, and another 50 points from latching..."
    - Autonomous is very point heavy
        - Start on hanging on latch then get off
            - Using one mechanism that we start on and hanging back up with the same mechanism
            - Use two different mechanisms (one easier to get off and one easier to get on)
                - Linear slide to get off
                - Just Drop with a release
                    - Requires orientation after release (Camera vision)
                    - If goes with approach, tests needs to be run to see reliability of dropping (phone may disconnect, etc.)
    - Most people agree
    - Hanging as second priority
    - Parking does not seem as a top priority
- Be able to do everything and carry yourself
- Mr. Prettyman believes
    - getting a quick chassis for ability to begin autonomous
    - If you're only able to hang – you will most likely be alliance captain/win early competitions
- **<u>Decided that autonomous and hanging are top priority</u>**
    - Third priority is scoring minerals – can get inspiration from other robots

Watched Robot in 30 Hours video for inspiration

Watched a video of Pros and Cons of Drivetrains to refresh memory on the various drive train

Patrick gave presentation on how to write a Journal Entry for meetings. He gives multiple example documents and a PowerPoint presentation. These documents included a rundown of the design process and a few example meetings. The idea was to base the notebook off of 7 steps of a design process. These steps are:

Design Process:

By Patrick Tiamson

(inspired by *Project Lead the Way)*

Title:	Title Should Be One/Two Word Summary of Problem ○ (e.g. "Drivetrain", "Chassis", "Harvester" "Intake")
Define Problem:	• Specify the problem • Document specifics (the number of points the problem is worth, the level of importance/priority)
Generate Concepts:	• Brainstorm solutions to the problem • Narrow down to a singular solution ○ Use Design Matrix ○ Analyze Pros and Cons
Develop a Solution:	• Create rough sketch of solution • Create CAD of solution *If Design does not show promise, go back to a different concept*
Construct and Test Prototype:	• Make a prototype based off of CAD ○ Can be rough of specific • Analyze outcome of prototype ○ "Prototype works with 80% accuracy"

	○ "Design may need tweaking – Prototype does not work very well" ○ "The plastic prototype doesn't work but the final mechanism will be made of aluminum and that should work" ○ "A tiny design change helped the prototype – Add to CAD" *If Prototype does not show promise, go back and improve the design*
Fabricate Solution:	• Fabricate a finalized solution based off of the CAD • Put item on robot
Evaluate:	• Evaluate the effectiveness of solution • Analyze flaws and where tweaks can be made
Tweak:	• Improvements and changes to final design

And they are loosely based off of the Design Process from Project Lead The Way's Engineering Design pathway. Using this linear iterative system, each component of the notebook can be logically organized. The process is made to follow the history of one component of the robot without being mixed up.

MOE Cheer was taught to new members

- OH-OH
- OH-OH
- clap-clap
- clap-clap-clap
- clap-clap-clap-clap
- GO MOE!

Date: 9/15/18

Duration: 6:00 PM – 8:00 PM

Saturday, September 15, 2018 Meeting

Students:	Conno r	Patrick	Paige	Clare	Ian	Bryan	Katy	Rohan	Jonas	*Karthik

*Karthik came to visit to see if he wanted to join the team

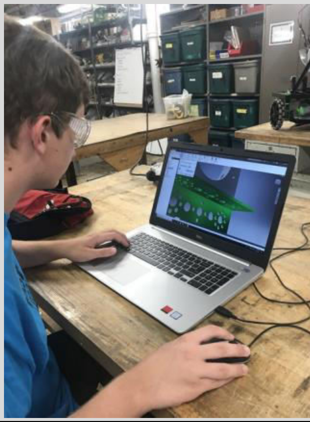
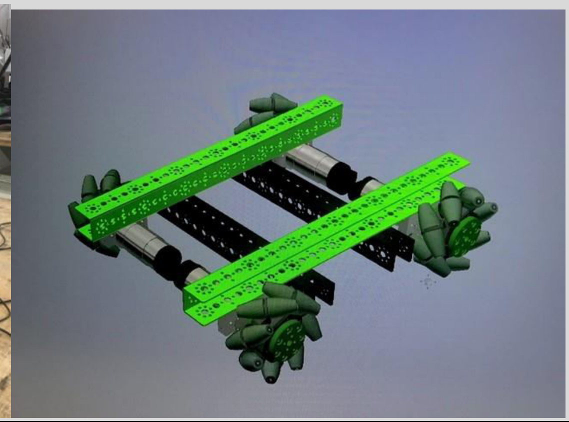
Mentors:	Mr. Prettyman	Mr. Szeto	Arnav	Zach

Agenda
Previous Meeting Discussion

Tasks:		
Plan/Overall Design	**Programming Chassis**	**Programming**
Students: Katy, Patrick, Bryan	Start working on Chassis for an early, so we can program earlier. **Students:** Connor, Paige, Ian	Start autonomous planning Get Vuforia Field Coordinates by the end of the day Students: Rohan, Jonas, Clare, Patrick

Mechanical Accomplishments:

Programming Chassis	
Problem: Create programming chassis for programmers	This is important since the programmers need a general prototype to test on.
Generate Concepts: Mecanum Chassis	During Tuesday, 9/11 meeting, team brainstormed the best possible chassis for our Rover Ruckus robot. We decided that the Mecanum Chassis was the optimal design

	for this year’s season.
Develop Solution	Since the team has made this kind of chassis before and all the parts were on CAD, the team began to build the chassis with Zach overseeing the progress.  
Test and Prototype	Currently the Chassis team is working on building the first prototype. • They made the mecanum wheels, and drilled them out so that the motors would be able to fit through the center. • The team members found that the hole in the center of the wheels was too small for the axel. As a solution, Zach, Paige, and Ian installed motor adapters on the mecanum wheels, then drilled the holes. • Afterwards, they put the mecanum wheels on the motor axel and screwed the set screws into the motor axel. • The team got Tetrix beams for the chassis & began attaching the mecanum wheels. • They then measured the distance from the center of one of the wheels to the center of the opposed wheel. In order for the chassis to make a square, the team used that distance to space out the wheels on the same side. • Paige, Karthik, and Ian mounted the motors on the Tetrix beams, placing the motors in mounts and screwing the clamps. • They put the two of Tetrix beams at a distance that made the four mecanum wheels form a square. • During the building of the prototype, Connor transferred the most important CAD files to the new CAD computer, and began the organization process for all the files. • After the prototype was complete, Connor worked on CAD-ing the programming chassis. • Paige, Karthik, and Ian got two more pieces of Tetrix beam and we screwed them onto the other 2 Tetrix beams. • They got a new Expansion hub and screw it onto the top of the middle beams of the programming chassis. • They found a slight problem of the end of the motors that willpower the wheels were different then the end of motor that can snap into the expansion hub. Then, they found four cable the snaps into that end of the motor cable and it has the cable end that can snap into the expansion hub • Next meeting or meetings, they have to tie the cables to the frame so they are not organized and entangled in the center. They also need to find a place to put or

	mount the phone and the battery. After that, it is ready for the programmers to start program with it. 

Programming Accomplishments:

Autonomous	
Problem: Create an autonomous	Autonomous is a high-scoring area, so it is prioritized.

Generate Concepts: Pre-Autonomous Planning	• High-level Autonomous Strat (works for every starting position):
	  ○ Drop
	  ○ Gold mineral
	  ○ The place team marker in depot
	  ○ Park in crater
	• Drop
	  ○ Use Camera for stabilization
	    ▪ Test for best Camera Position Vuforia on Joe’s robot
	    ▪ Create a coordinate plane
	  ○ Use Tape on Floor for stabilization
	  ○ Cannot do any of the autonomous if drop isn’t successful
	• Gold
	  ○ Find mineral using USB Camera to track yellow

Generate Concepts: Vuforia Planning	• Use units of 2 inches because the most important unit of measurement is the gold block (2 in.) • Coordinate Plane of Field goes to (72, 72) • Plan out important coordinate points: ○ Every point on the field designated as important (craters, sampling, etc...) were mapped to a Cartesian plane

	○ Red square bottom left is (0, 0) ○ Blue square top right is (72, 72) 

Non-Technical/Discussion:

Outreach on October 13th - Inner-city for Everest Students.

New Computer for CAD

- Connor Quickly set it up
- Imported all the old CAD files, and deleted unnecessary files

New Logitech Camera for Robot

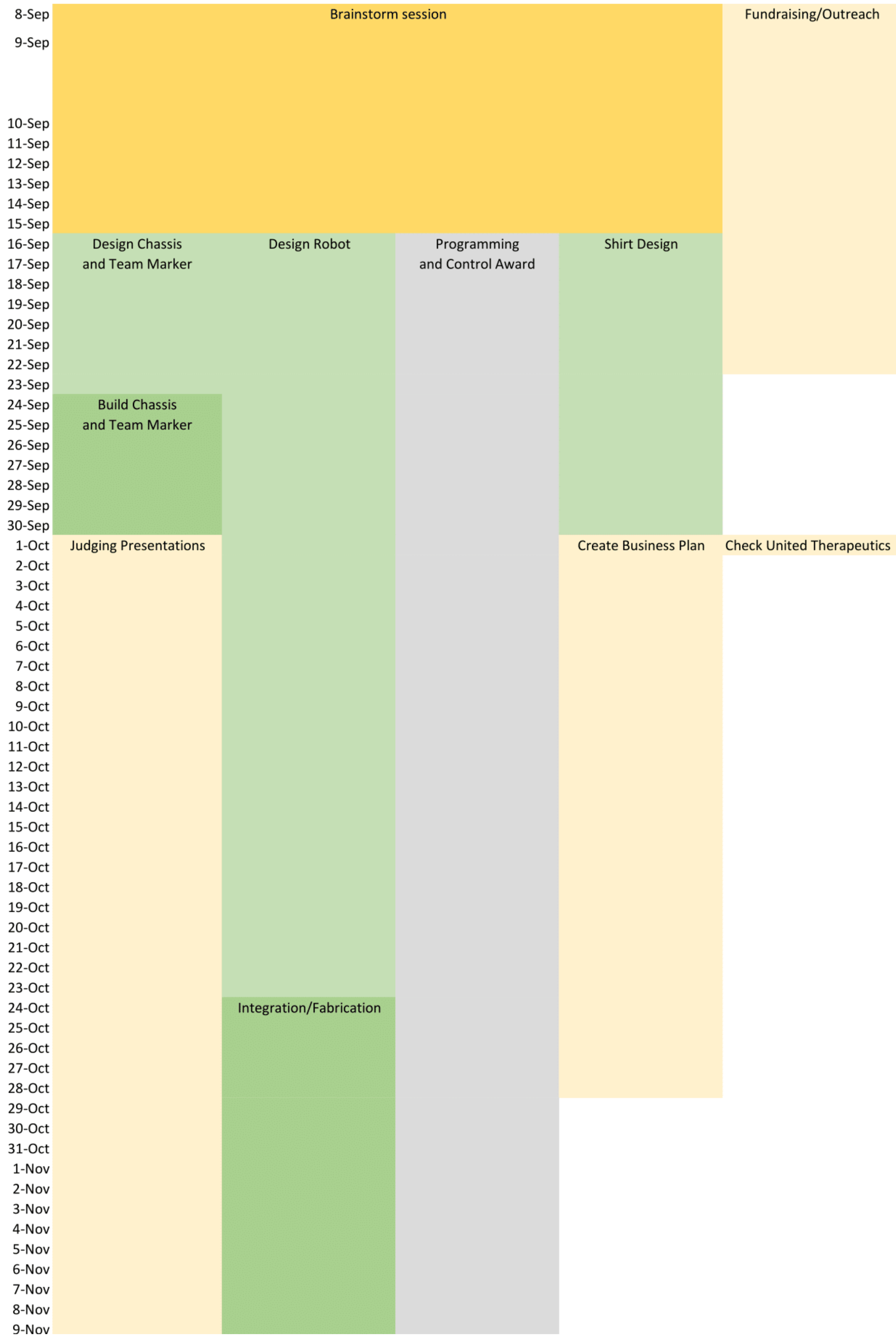
We used to do autonomous after mechanical design, but that did not give us enough time to test. It should be reliable, should not be hit-and-miss this year. This year will have a larger programming team and older students can teach new members.

Other relevant details for programming:

- Documentation of pseudo-code can explain code in English and it is great for judging.
- Create a notebook of testing and things that didn't work.
- Rohan will be main advanced programmer to teach others.
- Patrick will be liaison to other teams.
- Jonas and Clare will learn the programming on the way.

Bryan and Katy set deadlines for the year and designing MOE's overall action plan.

- Built with management reserve – added a buffer so we should not have to be changing deadlines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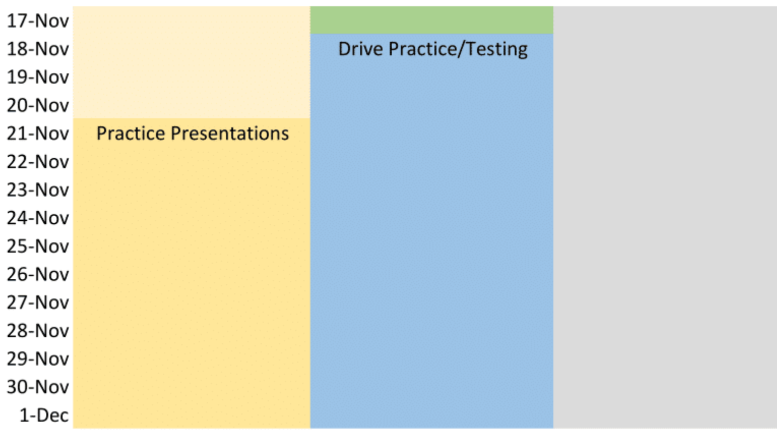
Brainstorm session
Fundraising/Outreach
Design Chassis and Team Marker
Design Robot
Programming and Control Award
Shirt Design
Build Chassis and Team Marker
Judging Presentations
Create Business Plan
Check United Therapeutics
Integration/Fabrication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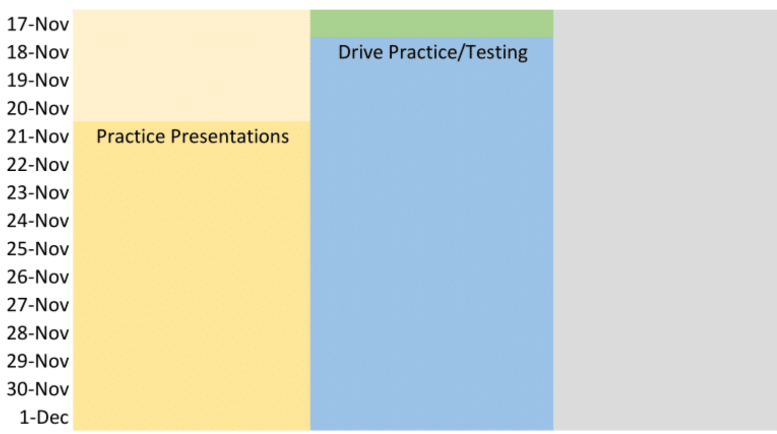
Practice Presentations
Drive Practice/Testing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1-Dec
Practice Presentations
Drive Practice/Testing

Date: 9/18/18

Duration: 6:00 PM – 8:00 PM

Tuesday, September 18th, Meeting

Students:	Patrick	Bryan	Katy	Rohan	Clare	Paige	Connor	Ian	Jona s	Karthik
Mentors:	Mr. Prettyman	Mr. Price	Mr. Buckingham							

Agenda
Previous Meeting Dicussion
Review Season Action Plan
ogress Update(s) from last meeting
Notebook Organization
Mr. Perotto Lab Safety Session

Tasks:	
Programming Chassis	**Programming**
Make wheels positions more square Add phone mount and battery mount Wire the phone	More Navigation with Cameras Test out Switching back and forth between two cameras

Mechanical Accomplishments:

Programming Chassis	
Test and Prototype	Currently the Chassis team is working on building the first prototype. • At the end of Mr. Perrotto's Lab Safety Session and before our team split into sub teams, the team saw that the direction of the rollers on the mecanum wheels were wrong. • The team also saw that the mecanum wheels were not in a square. • Paige, Karthik, and Ian swapped the mecanum wheels in the front and the back wheel of one side of the chassis by this by unplugging the motors attached to the two wheels from the expansion hub. Then, they unscrewed the motor mounts and then took the motors out. They switched the motors in the front and back motor mounts. After that, they put the top of the motor mount on.

	• While Paige, Karthik and Ian were switching the wheel with the motors, Connor was using the CAD of the programming robot to find a way to make the mecanum wheels in a square configuration. • Connor found a solution, which was to bring each tetrix beam with the motor mounts out one small hole in the tetrix beam in the middle of the chassis. He then showed it to the programming chassis build team. • Paige, Karthik and Ian worked on making the changes to the chassis that Connor told them to do. • Then, Andrew did a test to see if all the motors were working and the wheels were spinning. All the motors and wheels were spinning well. The only problem was the right-side back wheel was spinning crookedly because the wheel was not put on straight and the front right-side wheel was loose and almost spun off because the lead screw was not properly screwed in right. • From the motor test, Ian screwed the lead screw on properly and then, checked out the back right-side wheel and from the observation that the hole might not have been drilled in straight. • Ian tried to make the hole in the mecanum wheel straight for the motor shaft by using a hand drill because there was not a big enough clamp to use for the drill press. But, after Ian drilled the hole out again, it did not much to make the motor shaft to go straight in and the wheel to spin straight. • While Ian was drilling the hole in the wheel, Andrew, Paige Karthik, and Clare were cutting and drilling out a piece of Plexiglas to put on the top of the programming chassis.

Programming Accomplishments:

Autonomous	
Test and Prototype: Scaling and Orientation	Today the programming team worked on localizing the coordinates • Before Mr. Perrotto's Lab Safety Session, the team decided to test if Vuforia would work with two cameras by simply switching back and forth • After we split into our separate teams, Rohan worked on polishing up to code from last meeting • One big problem was that the coordinates received from the Vuforia tags did not take into account which side of the field the tags were on • Last meeting, Claire planned out important points on the field, resulting in the field ranging from (0,0) to (72,72) • That posed the second problem, the Vuforia coordinates were on a different scale than our ideal coordinates • Jonas and Claire first tackled the first problem. They formulated and tested math formulas that accounted for the side that the Vuforia tags were located on. • For the next problem, Jonas and Claire simply recorded how far 2 feet is in Vuforia units, and then converted it into our preferred scale.

	• Rohan then implemented the formulas into code. This part was very easy and quick • Rohan, Jonas, and Claire then tested the code by checking if the axis were correctly manipulated. • Now whenever the Vuforia webcam identifies one of the 4 pictures on the wall, it knows roughly where it is on the field. • The translation from Vuforia data to our coordinates in not exact, so we may need to do **more precise scaling the future**.

Non-Technical/Discussion:

Joe Perrotto gave instructions for Lab Safety and showed safety equipment and materials

Deciding how the robot will be built:

- Will robot be designed and then given to build team?
- Will robot be designed by individual build teams?
- More Guess and Check or More Brainstorming before Building?

- Build Sub-System and Continuously Improve at Start
    - List of Constraints
    - Decide how much space each place will take up
- Build Constraints around Priority List
    - If autonomous is number one and we need a good drive train
        - Then build constraints around drive train / landing

Odometry wheel in autonomous

- Can also turn wheelbase into modified Slide drive

Date: 9/22/18

Duration: 9:00 AM – 2:30 PM

Saturday, September 22, Meeting

Students:	Patrick	Katy	Bryan	Paige	Clare	Connor	Ian	Jonas	Karthik	Marcus	Rohan

Mentors:	**Mr. Prettyman**	**Arnav**	**Zach**

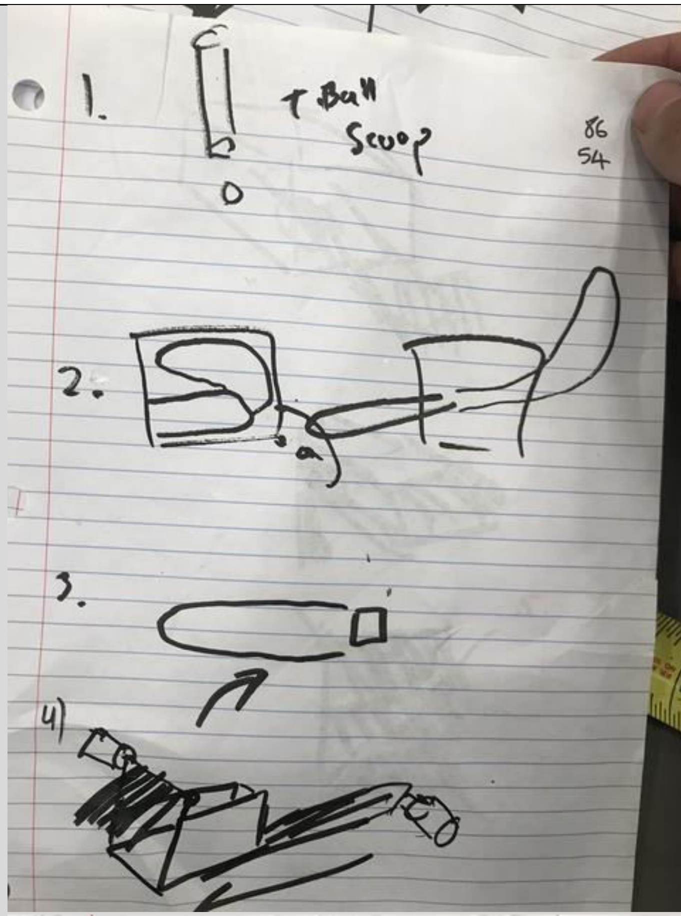
Agenda
Previous Meeting Discussion

Tasks:		
Mineral Management System	**Dropping**	**Hanging**
Start working on brainstorming designs Katy Rohan Marcus Patrick	Start working on brainstorming designs Paige Karthik Clare	Start working on brainstorming designs Bryan Connor Jonas Ian

Hanging split into dropping down (Auton) and hanging (End Game)

Mechanical Accomplishments:

Mineral Management System	
Problem: Mineral Management System	Scoring Minerals is lower priority, but it is the main scoring element in Tele Op
Generate Concepts: Overall Brainstorming	We started with gathering as many ideas as possible (show below)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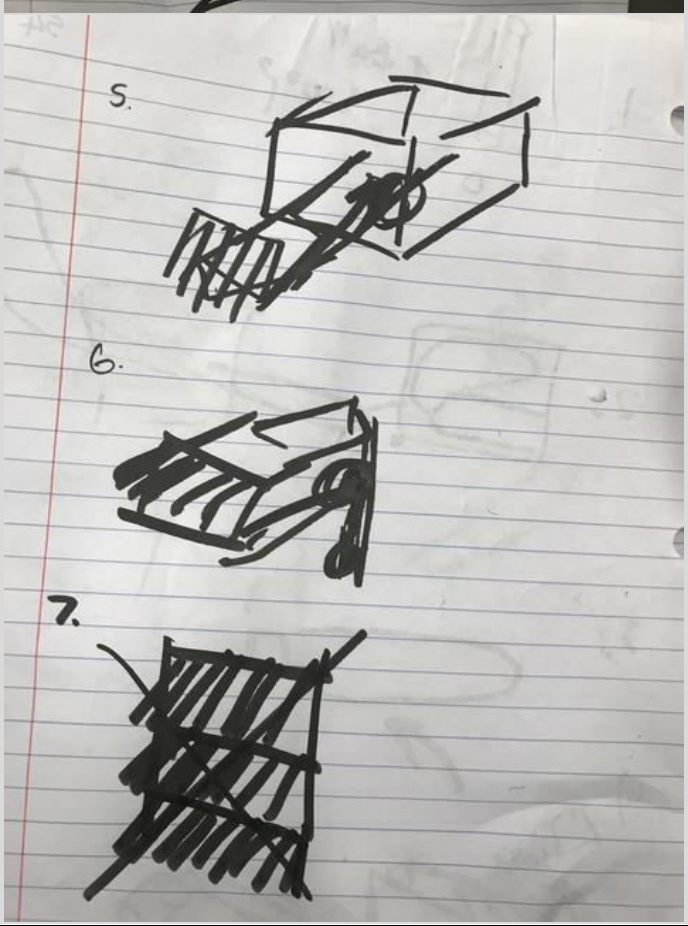
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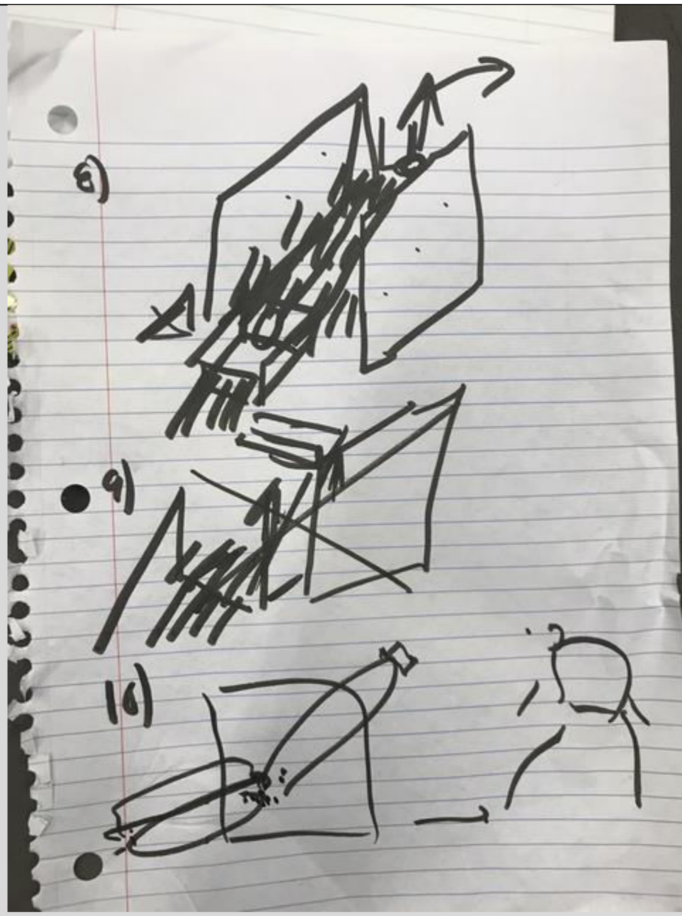


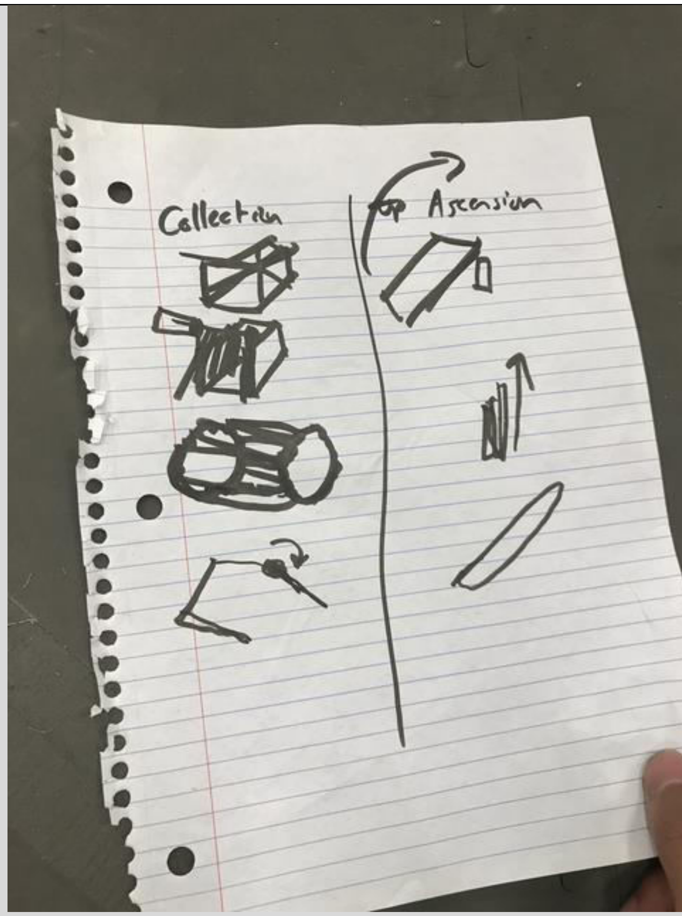
We did very rough sketches of our ideas and explained them to each other. We discussed various ways to get collect stuff such as:

- Scooper
- Suction
- Zip-ties
- Rubber bands

We also discussed various ways to lift stuff up to the cargo hold such as:

- Conveyor belts
- Shooting Mechanism
- Arm Mechanism

We then separated our ideas between collecting and ascending/scoring:

	 Later, Katy, Rohan, Marcus, and Patrick decided to split up the work into these two groups
Generate Concepts: Scoring	We decided to go with a shooting design for several reasons: • Since we prioritized hanging over scoring the minerals we knew that we did not have to have this completed right away • We wanted to reach a goal of 2 minerals every 6 seconds instead of making a slower design and then making a fast design later in the season • Shooting gets the ball up in the air very fast We went with a mortar-type design with a spring that shoots that minerals up in the air
Generate Concepts: Collection	Katy and Marcus planned a collector, and had four main ideas. • The first was a collector with pieces of surgical tubing attached, turning and collecting balls. Pros: MOE FTC has done this design before and it is quick Cons: This design will always push some of the balls away rather than collect the balls. • The next idea was a suction method, where a plunger sort of mechanism would pick the ball up and transport it to the launcher.

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Pros: simple to make

Cons: Balls could drop if the suction is not strong enough

• The third design was a similar to a tennis ball pick-up tube design, where the compartment would hold the balls that would be launched.

Pros: simple design, not much maintenance

Cons: could require two different designs to pick up the particles- cubes are a different shape and this design may not work with them, also very inefficient

• The last design was 2 sprockets connected by an axel, with rubber bands running along the circumference.

Pros: rubber bands are flexible and will mold to the shape of particle, simple to make since it is just putting rubber bands on a sprocket, and rubber provides traction/friction.

Con:

*Ultimately the last design won out since it was the most flexible/malleable design, it was simple to make, and it was very consistent.
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<td>Generate Concepts: Amalgamation</td>
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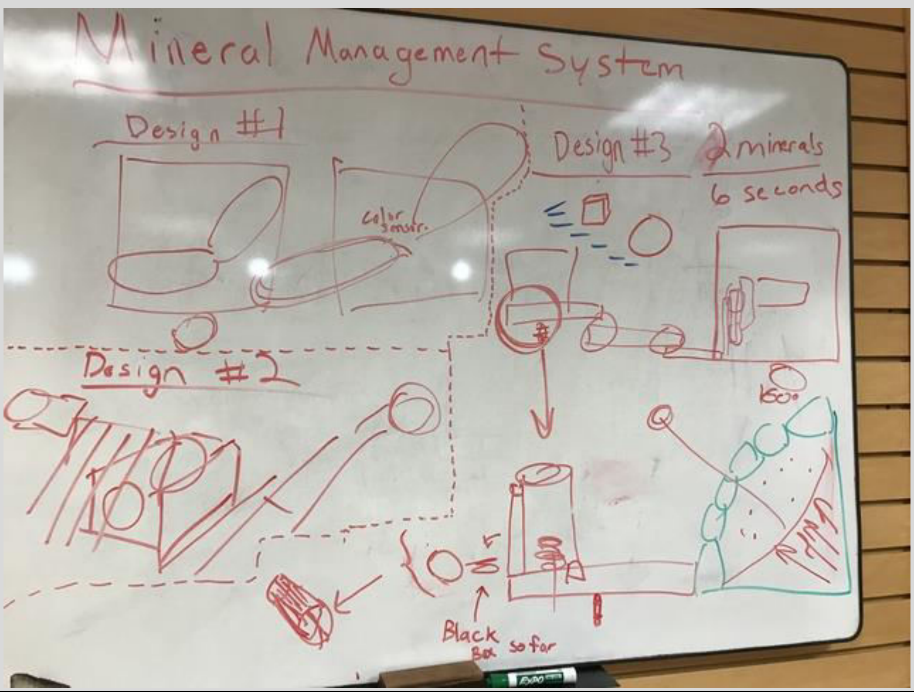
The two small teams grouped together and presented a more finalized idea to the team:


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<tr>
<td>Test and Prototype: Collection</td>
<td>For the collecting mechanism, Katy and Marcus first found two sprockets and connected it with an axel. They then tested out multiple patterns with different numbers of rubber bands. (Insert pictures). After finding multiple designs to test, they attached a motor hub to the collector prototype to see how effective each one was. They found that the thicker rubber bands weren’t as effective as the thinner ones since they got in the way of the ball’s path and slowed the ball down.</td>
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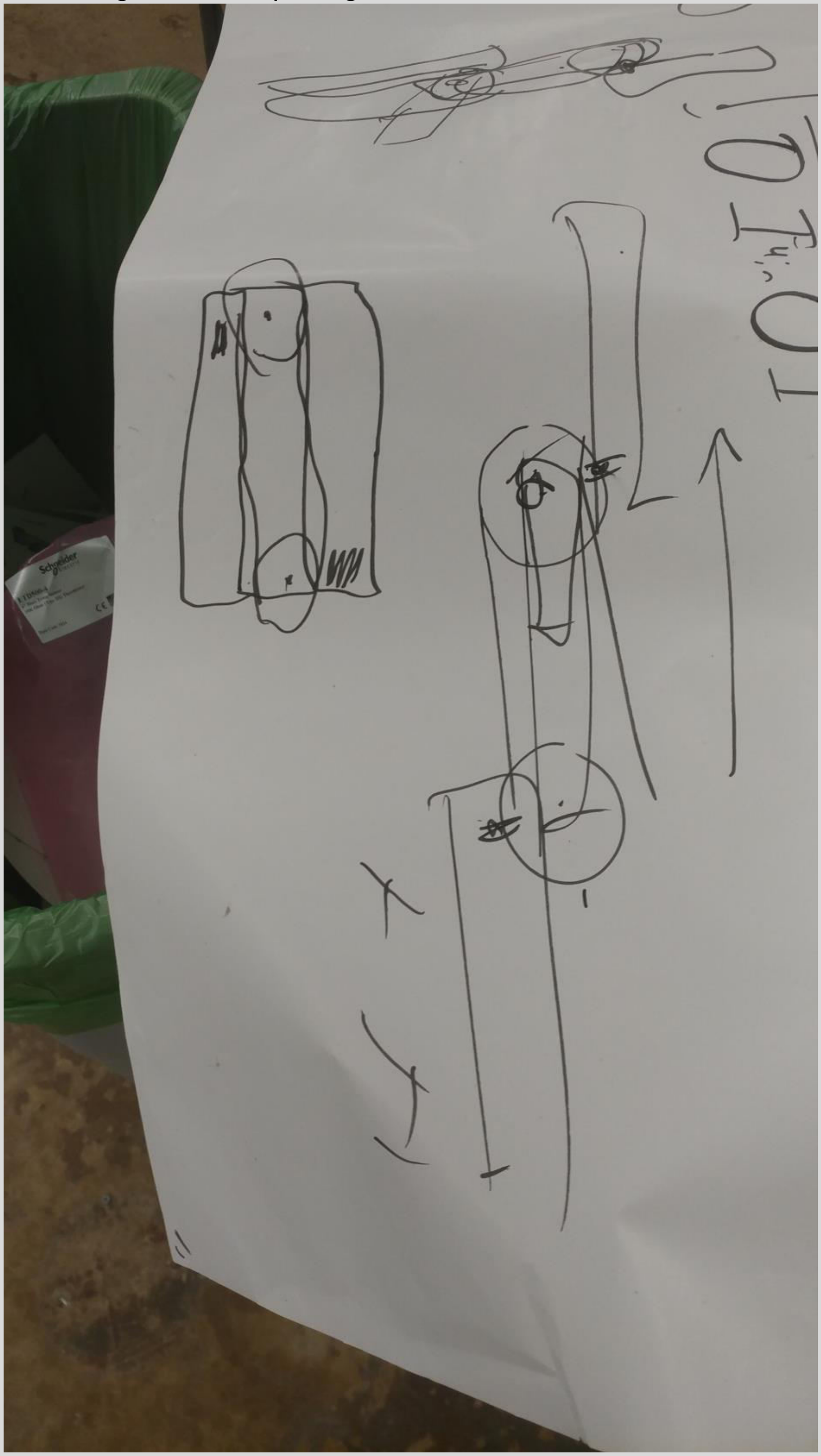
	Furthermore, the triangular designs worked better than the rectangular designs since triangles vary in width depending on where the particle is, and the collecting mechanism with a triangular design collected the balls/cubes quicker than the rectangular design. Through more testing, we tested different heights and it proved difficult to find a perfect height. If it was too low, it would push balls away; however, if it was too high, it wouldn't reach the gold minerals
Test and Prototype: Shooting	We attached a pole to a silver mineral and then drilled a hole into a piece of wood Then we pulled the silver ball with the pole through the hole with a spring underneath the ball. When it released, it shot up in the air 

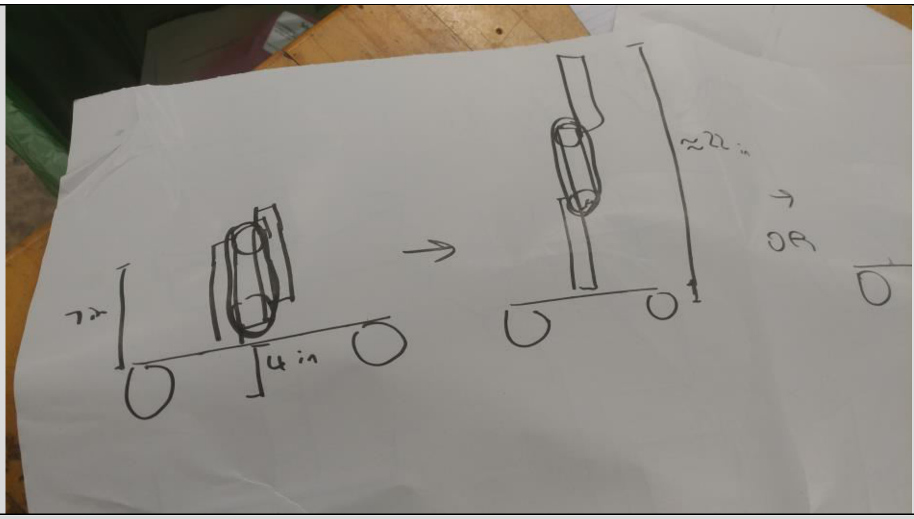
We used a PVC Pipe for guiding to test different angles

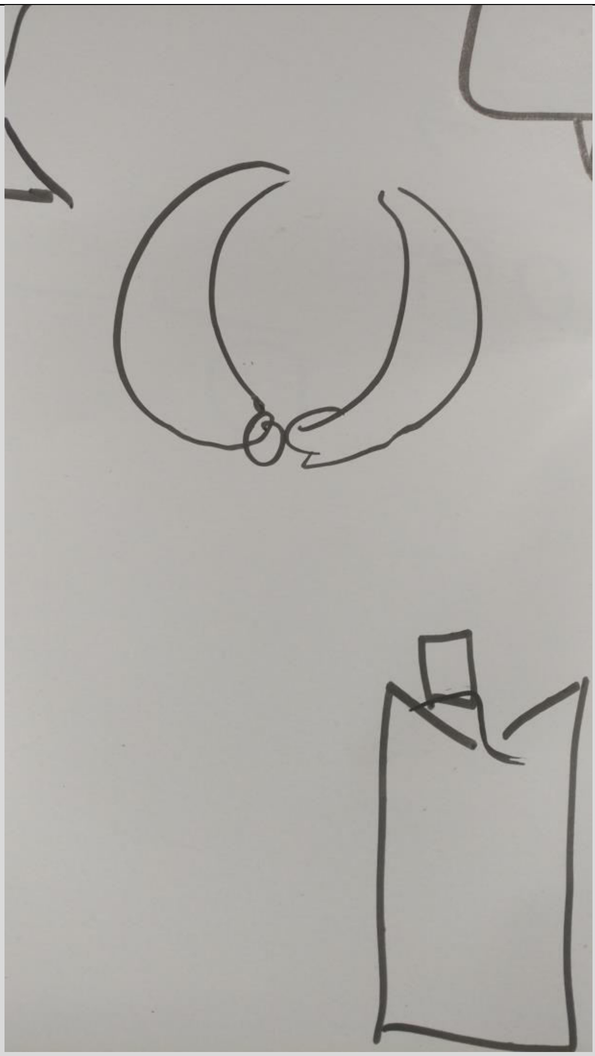
	At the end, Rohan decided that this may not be a good decision. It is an overcomplicated design that is prone to many errors. It would be very hard to accurately aim the minerals with consistency.

Dropping	
Problem: Auton Hanging and Dropping	In Auton, the robot has to hang from the rover and then drop or lower itself on the ground and detach from the rover
Generate Concepts: Overall Brainstorming	After some thinking, we had a few choices to discuss about. The first idea was like a parachute pin. There was a string that ran through the hook and locked into place on the robot. There was a pin that held it into place, and when it was pulled out, the string would let go and the robot would fall and the string was attached to a motor, and the motor would wind the string back up after. The pros of this design was the pin could easily unlatch and be wound up again, and it could have been done with just a servo instead of a motor. Some cons were that the string would have to be replaced, the robot would just freefall, and it will take about a full minute to set up for each match. The next step looking forward is improving the design so the robot can easily unhook from the rover and to find a way to cushion the robot's fall in the future for competitions. 

Hanging	
Problem: End Game Hanging	Making a mechanism that has a section that has a lifting mechanism and a section that has grab up to the hook on the lander spaceship in the middle of the playfield.
Generate Concepts: Overall Brainstorming	We decided to focus to on the hook design; but we knew we needed a lift mechanism and a hook mechanism.
Generate Concepts: Lift Mechanism	There multiple ways to get vertical lift mechanically. We gravitated towards chain-driven linear slide for speed and stability. We were hesitant with other designs because we wanted something that could pull the weight of the robot. We believed

	that string-based linear slides or rack-and-pinions were not stable enough for the job. Vertical rack-and-pinions are working against gravity, so that means that the gear could skip. You would also need a lot of torque, which means it won't be as fast. Strings can also slip and get undone.  Overall, we gravitated towards chain slides, so we could quickly start brainstorming the hook design.

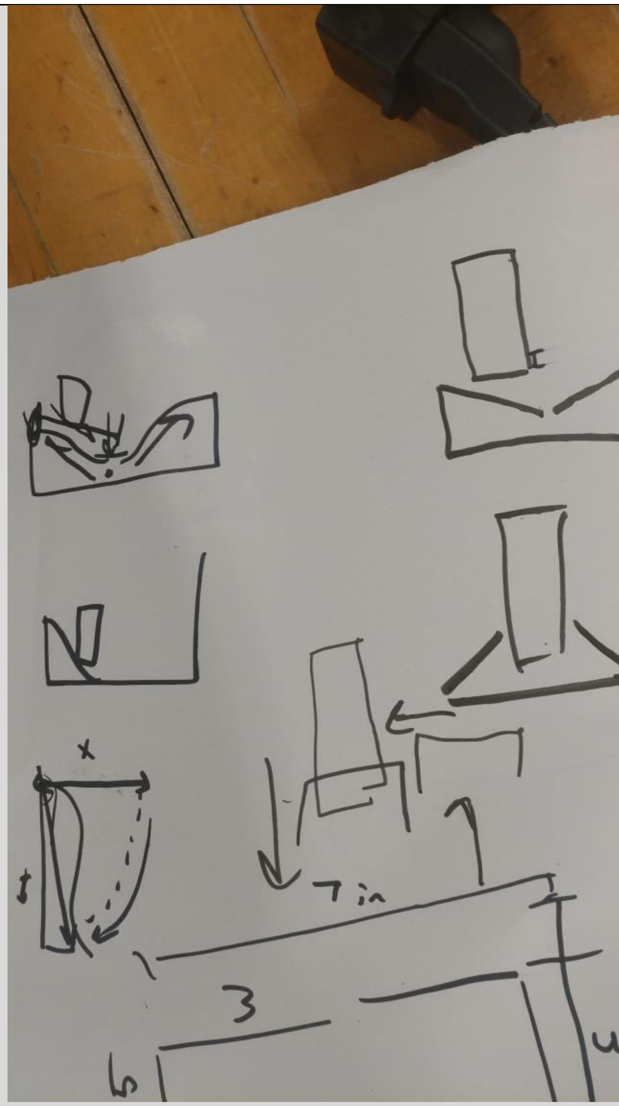
	
Generate Concepts: Hook Mechanism	We looked at various designs for the hook. Three designs came to mind: A claw, a pin system, and a carabiner-like system. Claw: This design would be closed shut using elastics and it would open up with a servo. This means we wouldn't need to keep the servo running to close up on the hook. Pros: It would accomplish the goal with minimum servo problems. Cons: It would need perfect driving for it to be fast. Not a lot of room for error. Possibility of breaking



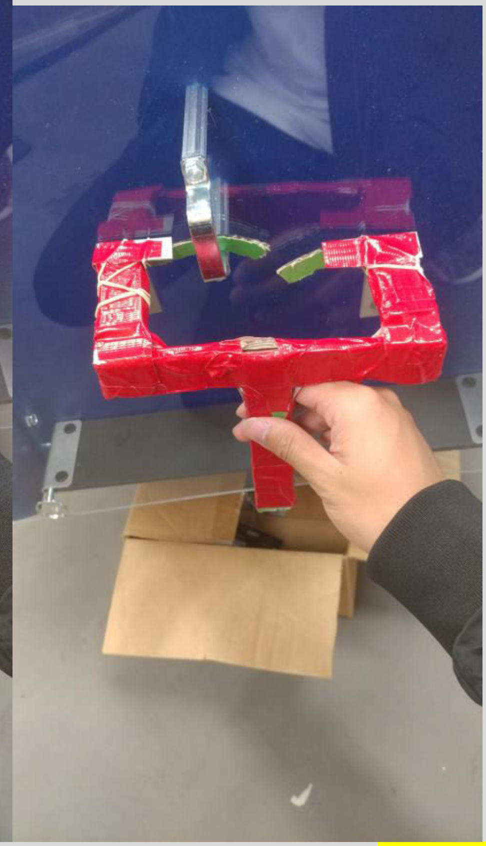
A Pin System:
This would use a pin that goes through the Landing Bracket and be mounted on two ends on both sides of the Landing Bracket.

Pros: Very stable, a lot of room for error
Cons: Moving parts may not work reliably

Carabiner:
This system would be similar to a carabiner in a way where you can push one way to open it, but it'll lock up the other way. This means we can push this mechanism through from under it, then we can pull up and it won't slip through the opening.

	 Pros: No servos, lots of room for error, mechanical stability, ease of building Cons: The design requires all parts to be strong or else it might break on one point Ultimately, we picked the Carabiner system because it works and it would be easy to get up and running quickly. We want our entire design process to be speedy. We decided that the arms needed to be curved and not straight to work right, so we made the arms base on a quartic function.
Test and Prototype: Carabiner	We made a quick cardboard/aluminum mockup of the sketch to check for feasibility

	 We checked if it would open up when pressed up against the landing bracket.

	  It seemed to open up and close up just fine, so we decided to go with a this design or designs similar to this.

Date: 9/25/18

Duration: 6:00 PM– 8:30 PM

Tuesday, September 25, 2018 Meeting

Students:	Patrick	Bryan	Katy	Karthik	Connor	Clare	Jonas	Paige

Mentors:	**Mr. Prettyman**	**Mr. Price**	**Andrew Szeto**	**Dave Buckingham**	**Tobi**

Agenda
Previous Meeting Discussion
Possible Christiana Outreach
ange Mineral Scoring Mechanism
National Chemistry Week Outreach
Progress Reports

Tasks:	
Dropping	**Programming**
Prototype dropper with a servo Paige Karthik Clare	Work on finding position on field Rohan Jonas

Mechanical Accomplishments:

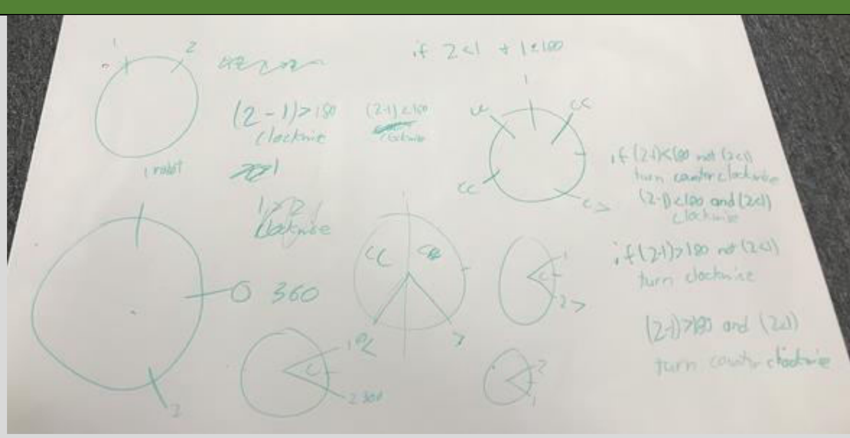
Dropping	
Construct and Test a Prototype	**Dropping:** Paige, Clare, and Karthik worked on prototyping a dropping mechanism using a servo rather than a motor. They talked about using a parachute release mechanism to reduce stress on the servo. The benefit of changing the motor to the servo was so that the team could save a motor and use it in another mechanism. They needed to build a rack and pinion to pull a pin out. In order to make the servo work, they had to find an adapter between the Tetrix servo and the Rev axle.


INSPIRE AWARD
2012-2013
ENNSYLVANIA
HAMPIONSHIP
COMPETITION
CHAIRMAN'S AWARD
2007
PHILADELPHIA REGIONAL
CHAIRMAN'S AWARD
2007
FIRST
CHAMPIONSHIP

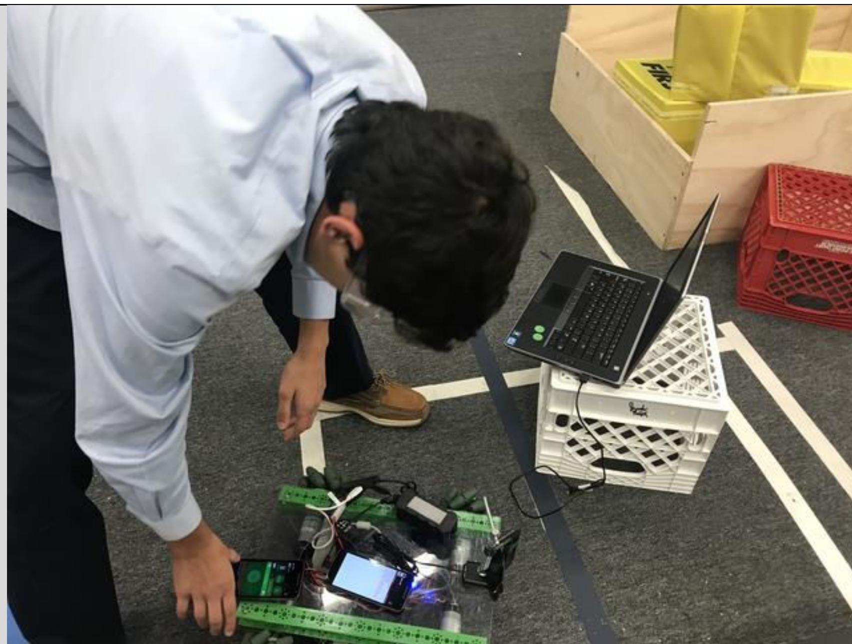
Programming Accomplishments:

Autonomous

Test & Prototype: Optimal Rotation



The math we needed to do here was to find which direction the robot should turn depending on its angle and the target angle. For example, it is inefficient to turn 355 degrees to the right when you can just turn 5 degrees to the left. The difficulty in the math comes when considering the 0-360 scale. So, the math formulas have to account for every case of the difference between the target angle and the current angle. This should work consistently.




FIRST
ROBOTICS COMPETITION
CHAIRMAN'S AWARD
2006
PITTSBURGH REGIONAL
FTC
INSPIRE AWARD
2012-2013
FIRST
ROBOTICS COMPETITION
CHAIRMAN'S AWARD
2007
PHILADELPHIA REGIONAL

The rest of the meeting Rohan and Jonas attempted to get the x and y coordinates by looking at a VuMark. They ran into a lot of bugs and determined to work on it next week.

Non-Technical/Discussion:

<u>Outreaches:</u>

Christiania Care: Dave Buckingham works at Christiana Care, so he is trying to get his boss to let our team run an outreach

National Chemistry Week: An event we have doing an Independence School – gathers a lot of student attention

Action Plan Progress:

Action Plan requires more details to make sure we are on task

Date: 9/29/18

Duration: 9:00 AM -2:30 PM

Saturday, September 29, 2018 Meeting

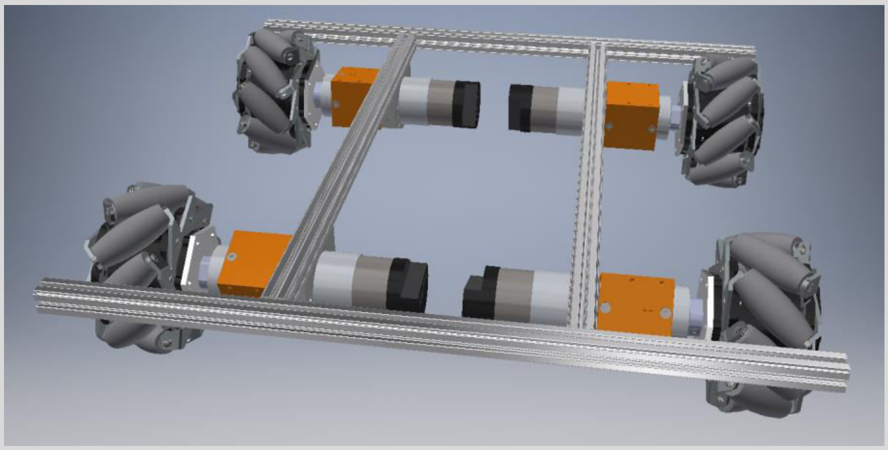
Students:	Connor	Bryan	Patrick	Rohan	Clare	Ian	Paige	Jonas	Katy	Karthik	Marcus
Mentors:	**Mr. Prettyman**	**Zach**	**Arnav**	**Andrew**	**Tobi**						

Agenda
Previous Meeting Discussion
Notebook Review
hedule Review
Report from teams

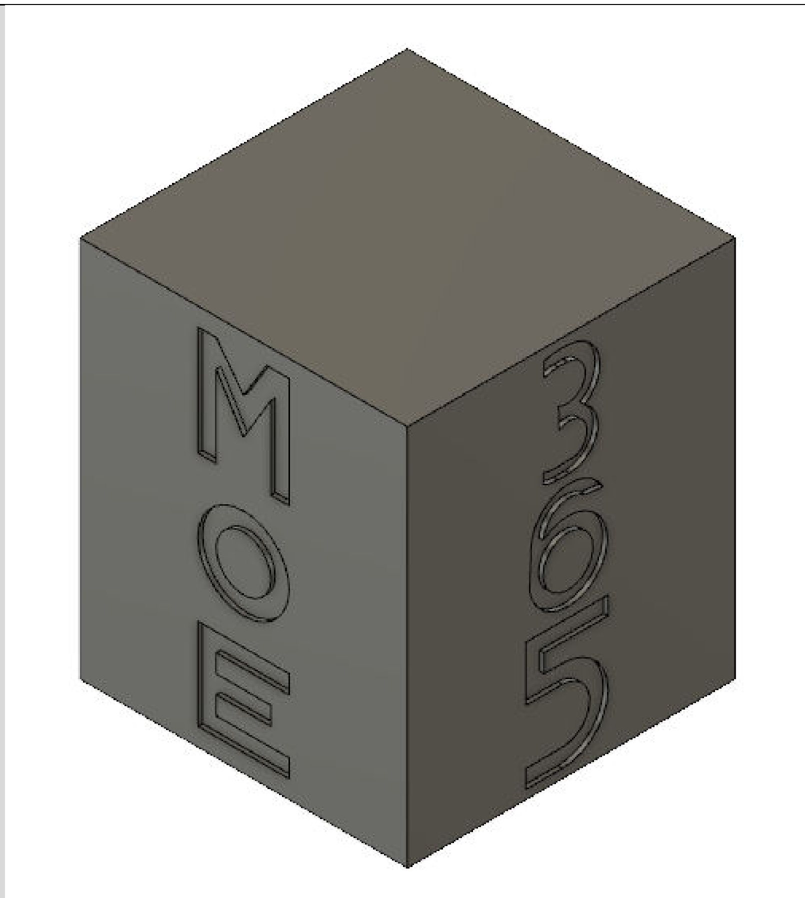
Tasks:		
Shirt Design	**Dropping**	**Mineral Management System**
Start creating and brainstorming more efficient shirt designs Connor Patrick Katy	Test String System for viability Paige Clare Karthik	Start planning and brainstorming how and how quickly we are going to score the Minerals
Programming	**Chassis**	**Team Marker**
Intelligent **point to point** movement of Robot during Autonomous VuMark Localization	Start CADding the chassis Connor	Show team the different designs for the team marker and see if they have ideas or changes for it CAD the changes and show the team again. Then, start printing the team marker. Ian

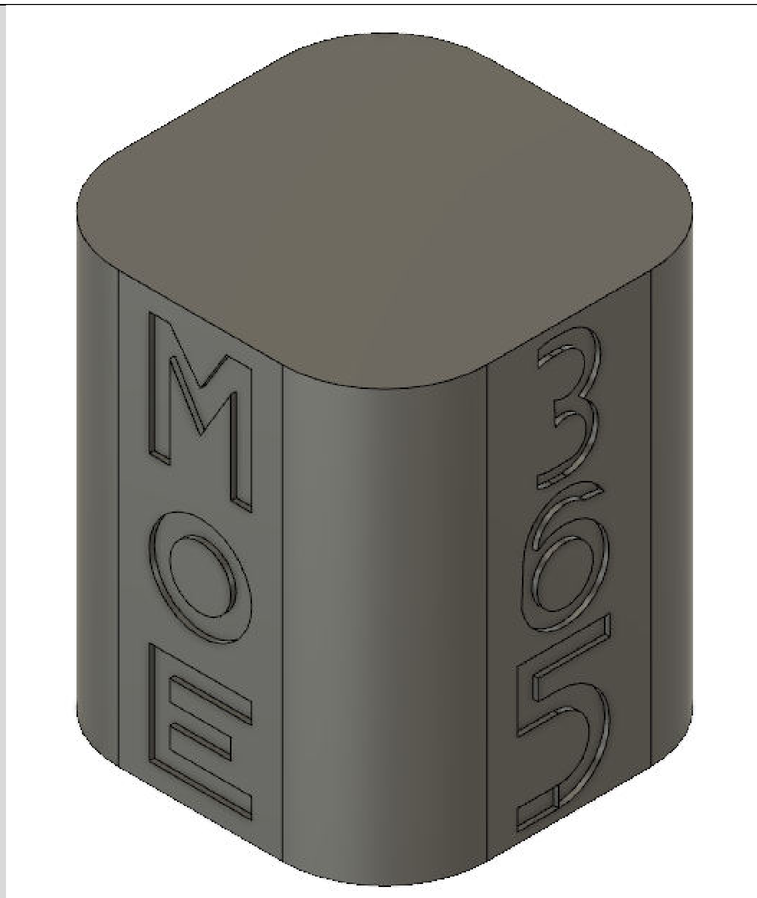
Rohan Jonas		

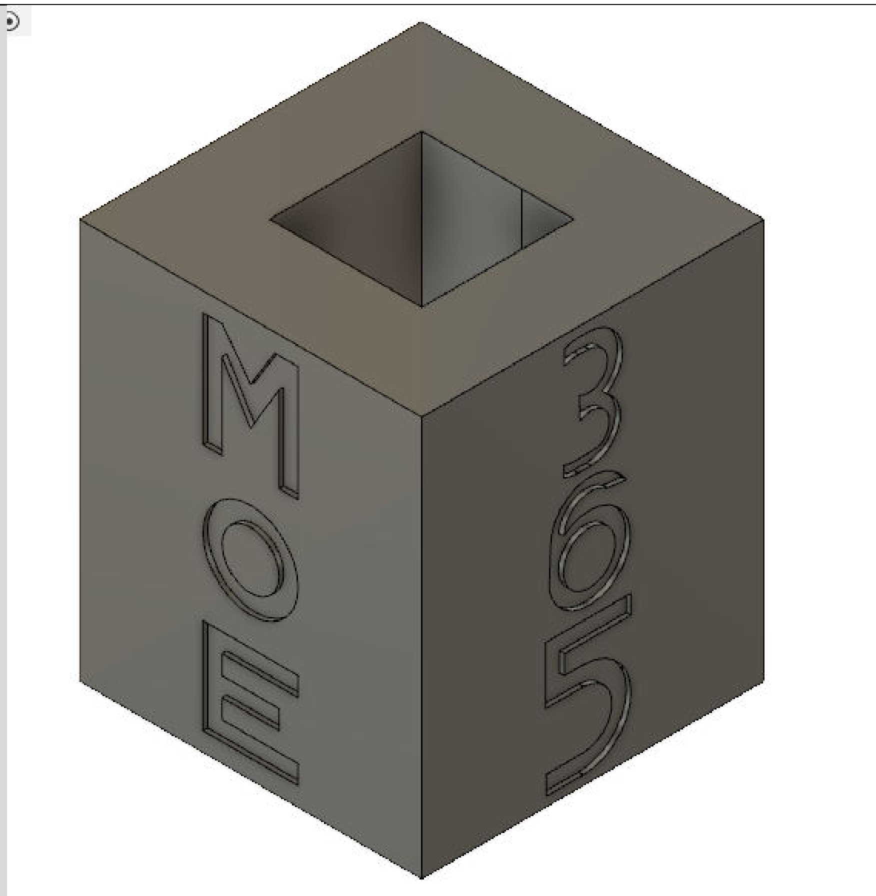
Mechanical Accomplishments:

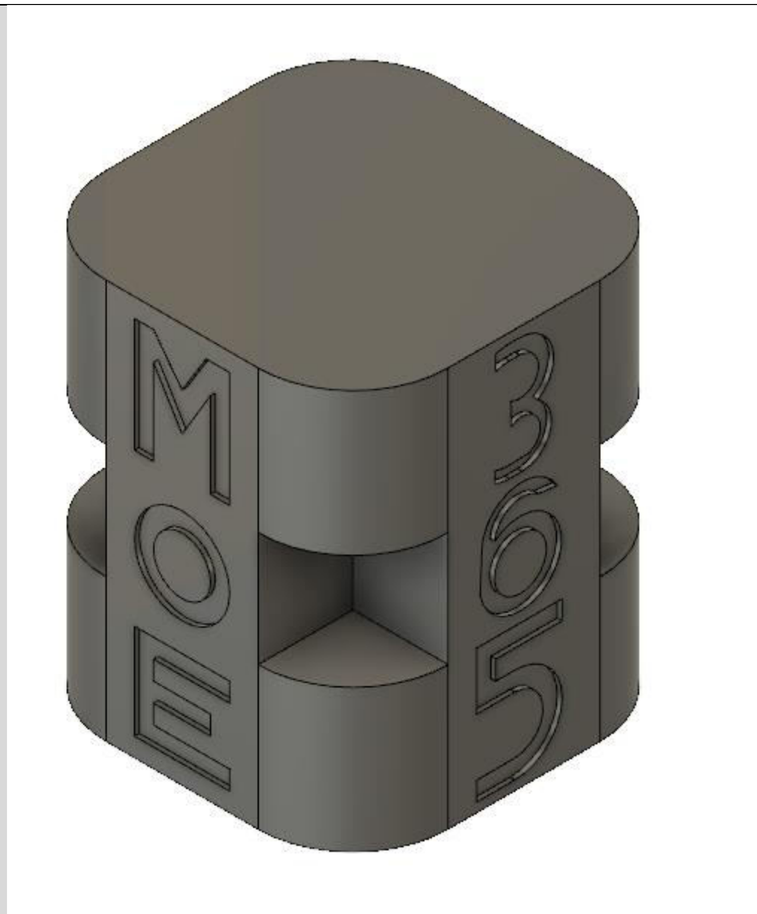
Chassis	
CAD the Chassis	Begin CADding the Chassis, but do not finish. 

Team Marker	
Problem: Team Marker	We need a Team Marker that is that is between the sizes of 3 × 3 × 4 inches and 4 × 4 × 8 inches.
Generate Concepts: Rectangular Prism	The first design Ian CADded was a rectangular prism. Ian started at the end of the last Saturday meeting and finished at home. It has our team name on two sides and the team number on one side. The dimensions of it are 3.6 × 3.6 × 4.2

	 Pros and Cons: It has flat surfaces to grab on. Even though the surfaces are flat, the robot grabber you would need a really wide extending grabber to grab onto the surface. Also, the sides of the model are too sharp for grabbers to grab on to them well.
Generate concepts: Rectangular Prism with curved side edges	For the original design of the rectangular prism, Ian thought of what he could do to change it make it easier to grip. The first idea that came into his mind was to curve the edges.

	 It has flat surfaces to grab on. It has curved edges for a grabber to grip on to. Even though the surfaces are flat, the robot grabber would need a wide extending grabber to grab onto the surface.
Generate concepts: Rectangular Prism with a vertical hole through it	This team marker is also an idea that uses the original rectangular prism. It is a rectangular prism that has a hole going through it from the top to the bottom. This way it would be easier to grip because the grabber claws do not need to be far apart.

	 It has flat surfaces to grab on. It is easier to grip because the grabber claws do not need to be far apart. The grabber would need to be in a place where its grabber and the marker would fit so it would need to be up higher on the robot.
Generate concepts: Rectangular Prism with curved edges and side grips	Ian showed the team his team maker designs he made before the meet at the beginning of the robotics meet. Mr. Prettyman and Arnav suggest that Ian should put side grips or notches of better grip. It would be a better place to grip because of the notches in the model. When the grabbers are gripped onto them, if they slip up or down the grabber would just hit the top or bottom of the notch rather than fall of the team marker. Then, Ian designed a rectangular prism with curved edges and 1 in deep notch in the curved edges.

<table>
<tr><td></td><td>

When the grabbers are gripped onto them, if they slip up or down the grabber would just hit the top or bottom of the notch rather than fall of the team marker.</td></tr>
<tr><td>Construct Prototype: Rectangular Prism with curved edges and side grips</td><td>After Ian showed the CAD of the team marker with side grips to Mr. Prettyman, he turns on the Prusa i3 mk2 3D printer and starts to Slice the CAD object with a Slicing software to print it. Slicing is when we take a CAD object in a .stl file and turn it into a file that is a bunch of coordinates for each layer of the object for the printer to use to printer it. This a .gcode file. With a Slicer software, you can also set the layer height, number of perimeter or outer wall. infill percent, infill design, and if you want to print supports or not

Ian sliced the model with 2 perimeters, 0.3 mm layer height and 10% infill.

Then, he put the gcode file into the 3D printer with a SD card. Andrew and Ian started printing it.

But, Andrew and Ian came to a problem. The problem was that the glue stick they used for putting on the printer bed for adhesion dried up and they tried to put some glue on the bed.
When they started the print the first layer did not stick to the bed so they stopped the print</td></tr>
</table>

- They used Simplified 3D to slice the team marker and hardwired the computer to the printer and the computer send the printer the printing coordinates.
- Then, they tried to put more glue on the 3D printer bed and started the print again but the first layer of the print did not stick. So, they stop the print again.
- Then, they searched masking tape to use as an adhesive and put it on the printer bed.
- Then, they started the print again and the first layer stuck the bed and print perfectly.

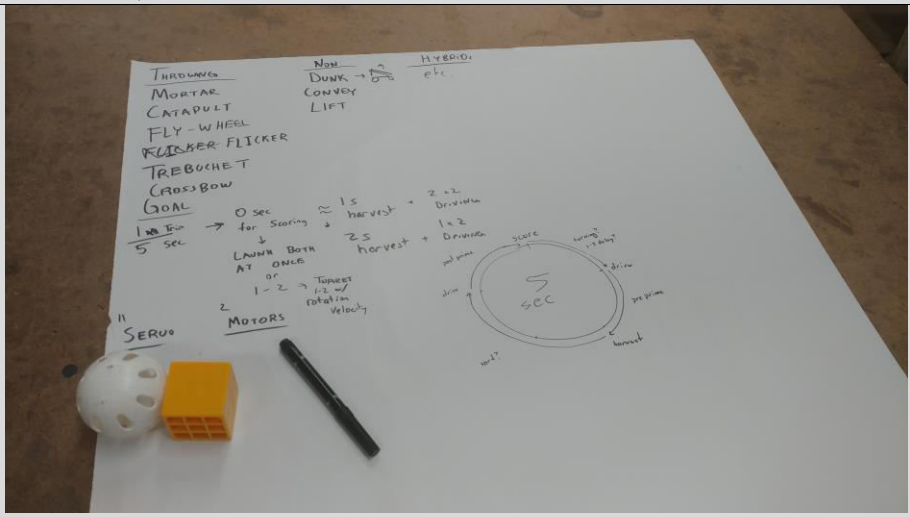
Ian watched the printer print the first layer and then went to do something else.

Mineral Management System

Problem: Mineral Management

We need a method to score Minerals, with hopes that we can score it quickly enough to be competitive in the late-season.

Generate Concepts: The Drawing Board



Explanation:
We made a list of possible mechanisms and separated it into two lists: Throwing, or mechanisms that require launching minerals into the lander, and Non, which are mechanisms that don't.

Throwing: Mortar, Catapult, Fly-Wheel, Flicker, Trebuchet, Crossbow

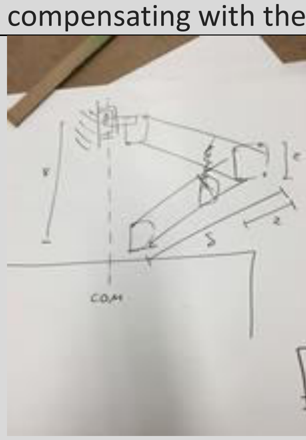
Non: Dunk, Convey, Lift

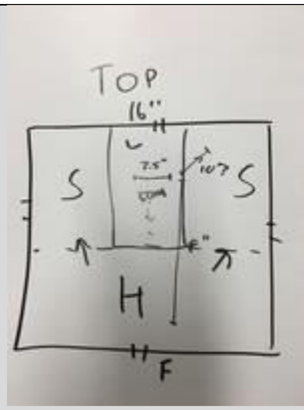
And we decided that we could also combine two mechanisms together, but the possibilities are endless. For example, one could lift a fly-wheel shooter for a better angle. This would be combining "Lift" and "Fly-Wheel"

We defined the ability to competitive as being able to score ¼ of the minerals: meaning we will be carrying "our own weight." We calculated that as about 2 minerals every 5 seconds.

With this ambitious goal, we said we needed either:

	0 seconds for scoring, 1 second for harvesting, 2 seconds for driving, Or 0 seconds for scoring, 2 seconds for harvest, 1 second for driving 0 Second scoring would mean that we would need to prime our scoring mechanism before we get to the Lander. We believed that the second option made more sense because it would take a while to harvest, but we don’t need to drive that far. And we know that we have 11 servos and 1 motor left.

Hanging and Dropping	
Problem: Hanging and Dropping Mechanism	We need a method to score Minerals, with hopes that we can score it quickly enough to be competitive in the late-season.
Generate Concepts: Worm Gear + ½ Scissor Lift	Through testing, we could not get the String Dropping System working. We decided to combine Hanging mechanism with the Dropping mechanism; however, this would require a large upgrade because a motor cannot hold a robot for an extended period of time with maximum stall torque. The idea was to combine speed with durability. In order to get speed, we are using a lever. This means we can use a motor to lift it at a ratio of 1 to the length of the arm times sin(45). To put it simply: If we raise a lever by 1 inch, 1 inch from the pivot, the result height will be approximately 70% the length of the arm. We are getting durability by raising the lever with a worm gear. This is a screw that will increase torque by the factor that it decreases speed by. This is so we can hang for an extended period of time and the worm gear will never back drive. We are compensating with the lost speed by using the aforementioned lever.
Develop a Solution: Worm Gear + ½ Scissor Lift	 This is a sketch of the idea. It will be mounted to the base of the robot, and the dimensions and range of motion are marked.

<table>
<tr><td></td><td>

This is about where it would go on the robot with the harvester at the front and scoring systems on the side.</td></tr>
<tr><td>Construct and Test Prototypes:
Worm Gear + ½ Scissor Lift</td><td>
Made a prototype out of cardboard test the concept.
It seems to extend properly.</td></tr>
</table>

Programming Accomplishments:

<table>
<tr><th colspan="2">Autonomous</th></tr>
<tr><td>Test & Prototype:
VuMark Localization</td><td>Localization of robot position from VuMark – when given a VuMark on a webcam, the robot can figure out its x, y coordinate on the field.</td></tr>
<tr><td>Test & Prototype:
VuMark Point to Point Movement</td><td>We made an initial program that the robot used. The goal was to go to a certain (x, y) coordinate on the field after the robot localizes its position prior with a VuMark.

This initial sketch proved to be too simple, as it utilized simple turning and linear motion to drive to new points. It would drive in a straight line to the new point, constantly checking for a VuMark to update its accuracy and turning angle. This ended up being too simplistic, as the angle to the VuMark would sometimes be too skewed for the webcam to recognize.

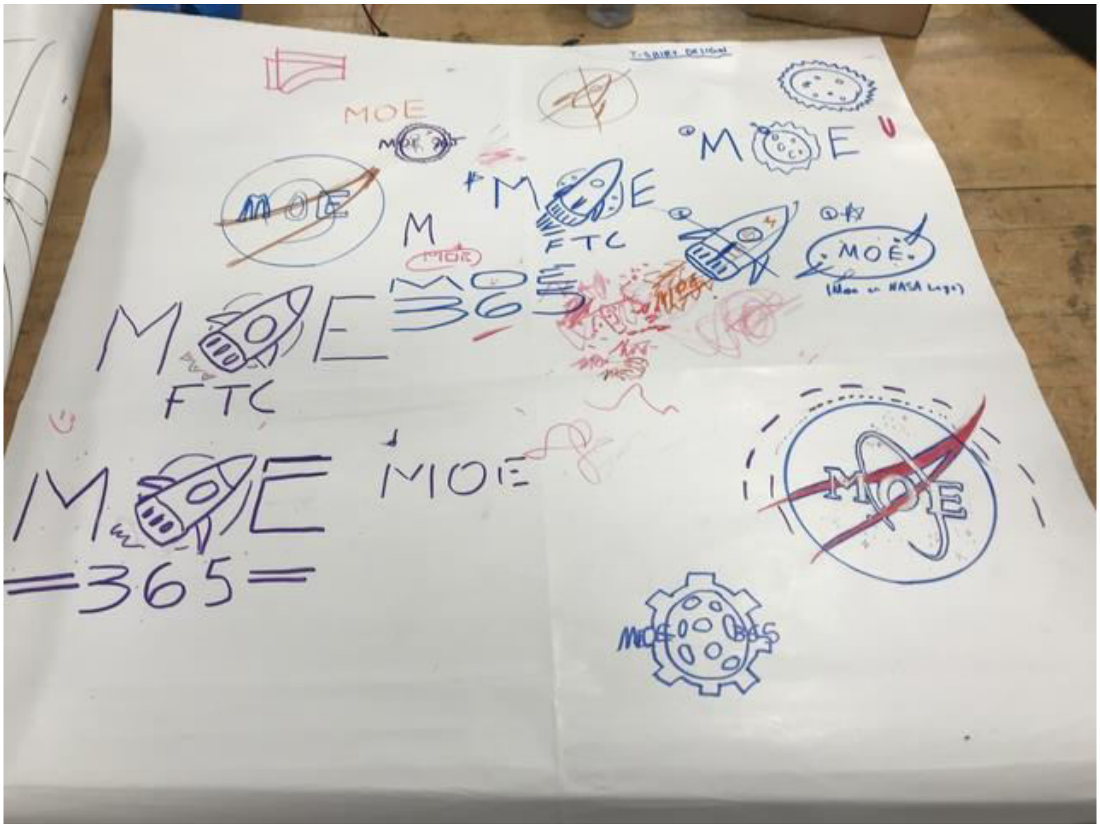
Test Success/Failures of Robot Intelligent Point to Point Movement<table><tr><th>Test type</th><th>Results</th></tr><tr><td>1 – Straight on Mars VuMark, go</td><td>Successful first turn, fails when</td></tr></table></td></tr>
</table>

		to Rover VuMark	trying to better align with the Rover VuMark as the program runs.
		2 - Slightly to left of Mars VuMark go to Rover VuMark	Successful first turn, fails when trying to better align with the Rover VuMark as the program runs.
		3 - Slightly to right of Mars VuMark, go to Rover VuMark	Successful first turn, fails when trying to better align with the Rover VuMark as the program runs.
		Consensus: Program successfully turns the correct angle on the first turn but subsequently fails to recognize the VuMark as it goes forward. The angle relative to the VuMark is too skewed to allow the webcam to recognize.	
	For the future, we would have to test a program with a more complicated approach.		

Non-Technical/Discussion:

Notebook Review:

Shirt designs: We started making designs for our team shirt this year. We created several designs, including a logo with the moon and a gear, a design with a rocket and the N.A.S.A logo but it says MOE instead of NASA. We drew the designs on a large piece of paper using pens and markers. We decided that the NASA logo design could go on the back of the shirt with the names of team members around it. We did not decide what design would go on the front yet. The back of the shirt could be in color but the front will be black and green like every other year.


T-SHIRT DESIGN
MOE
MOE
MOE
FTC
MOE
365
MOE
FTC
MOE
=365=
MOE
MOE
(Moe in NASA Logo)
MOE

Date: 10/2/18

Duration: 6:00 PM – 8:30 PM

Tuesday, October 2, 2018 Meeting

Students:	Patrick	Connor	Ian	Clare	Paige	Rohan	Bryan	Jonas
Mentors:	**Mr. Prettyman**	**Mr. Price**	**Mr. Szeto**	**Mr. Morrill**	**Mr. Buckingham**			

Agenda
Previous Meeting Discussion
STIMS
st Responders Day
Horsey Tickets
Hope Street Delaware
Review Wizards.EXE Ri3D
Review robot design and build status
Notebook status update and review
Project Overview
Grant requests, and Business plan

Tasks:		
Project Plan	**Programming**	**Team Marker**
Look over Project Overview and Reflect on our progress	Discuss new approach for point to point movement: A* Pathfinding Algorithm Mapping of FTC field to A* points	Check out how the Team marker printed out.

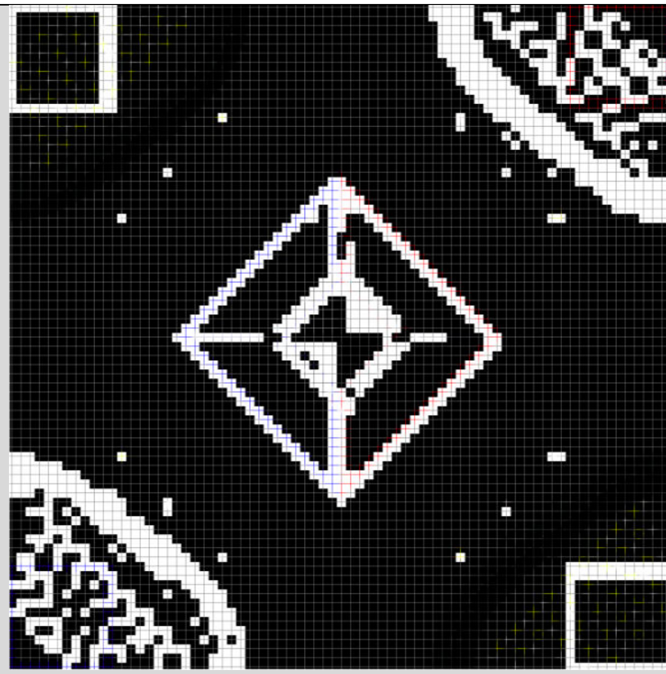
Mechanical Accomplishments:

Team Marker	
Construct Prototype: **Rectangular Prism with curved edges and side grips**	Ian took the complete print of the team maker off the printer bed, which was surprisingly easy with the making tape on. He took off the support material that printed in the side grips or notches. Then, he showed the other team member and mentors the completed print.

	After that, he found the tool to take the support material out of the Team name and team number. The team marker came out very well except for a crack on the middle of each side. He did not know where those cracks came from. Finally, Mr. Prettyman told Ian to make a design of a team marker that has the dimension of 3 x 3 x 6 and was like the first team marker but looked more like a totem and to make another design.

Programming Accomplishments:

Autonomous	
Discuss new approach for point to point movement: A* Pathfinding Algorithm	Rohan, Jonas, and Claire discussed the pros and cons of the A* Pathfinding Algorithm over the initial simplified direct turning algorithm. **Pros:** • Incredibly accurate (in theory) • Can be easily adapted & modified once initial setup is done • Directional movement in both 4 (N, S, E, W) and 8 (N, NE, E, SE, S, SW, W, NW) directions **Cons:** • Hard implementation & debugging time • Higher learning curve to grasp concept In the end, we decided to go for the A* since it offers significantly higher benefits over the initial algorithm. Despite the harder implementation, we felt the benefits outweighed the longer development time.
Mapping of FTC field to A* points	In the A* Algorithm, a map of the FTC field is required to allow for intelligent pathfinding. Rohan wrote a ***Python script*** (small program) that took in an image of the FTC field, converting it to points (represented as an array) that the robot was and was not allowed to travel on. **Mapped FTC Field (Visual Representation of Array)** 1 (or white) = point a robot cannot travel on 0 (or black) = point a robot can travel on

	 For next meeting, we only have to implement this map within the A* Algorithm, since robot localization is already figured out.

Non-Technical/Discussion:

STIMs – only Clare has STIMs – Students need to start working on getting registered

First Responders Day - Saturday, October 13. 1 PM-5PM

Independence School - November 3 – National Chemistry Week – An Outreach that we have been going to for many years

Collect team dues and distribute Horsey tickets – Horsey Tickets are meant for fundraising for the team, but it is also a raffle to win a car

Hope Street Delaware is an organization that helps at-risk youth in the Wilmington area. They may be starting a team and I was wondering if we can offer them some support or even visits to a few of their meetings to help them get started. I do not have details yet. This may be great opportunity for helping others, outreach and community service. Looks great on the college applications.

DuPont Wifi did not provide a strong enough connection to showcase Wizards Video

Date: 10/6/18

Duration: 9:00 AM – 2:30 PM

Saturday, October 6, 2018 Meeting

Students:	Patrick	Bryan	Connor	Jonas	Rohan	Karthik
Mentors:	Mr. Prettyman	Tobi	Arnav	Zach	Andrew	

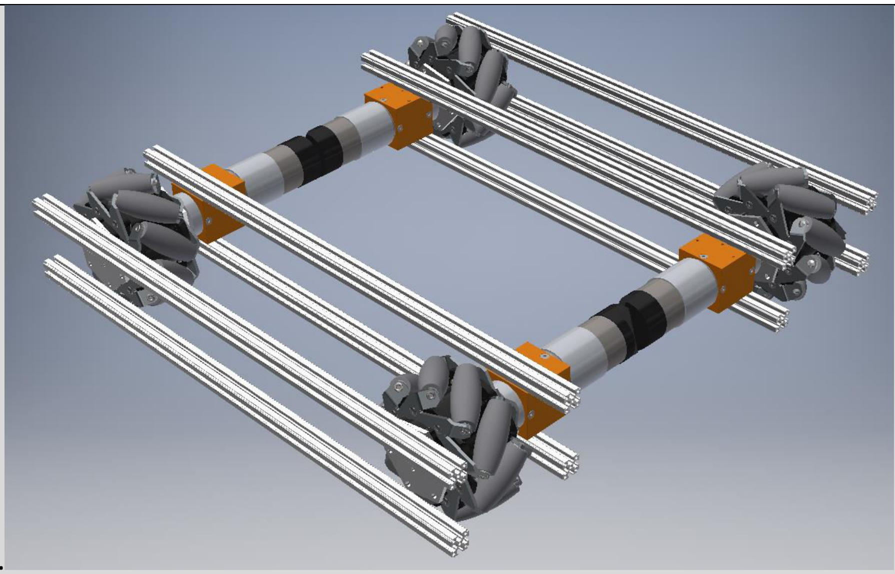
Agenda
Previous Meeting Discussion
t Demo bots working for Next Week's outreach

Tasks:		
Chassis	**Judging Presentation**	**Programming**
Get started with CAD (Hopefully finish by 11:30) Connor Bryan	Start working on the Judging Presentation	Implement A* Pathfinding Algorithm Rohan Jonas Clare

Mechanical Accomplishments:

Hanging	
Develop a Solution: Problem with Chain Driven Linear Slide	*stall torque at smallest sprocket with a NeverRest 40 at 0 power* will only give enough torque & force to hold robot for 20 seconds prior to auton – chain driven linear slide may not work

Chassis	
Develop a Solution: CADing the Chassis	Connor continued CADding 2 versions of the Chassis – one with 17 in beams and one with 420 mm beams. Our team decided that 17 in beams would be ideal, but one of the default sizes of REV beams is 420 mm (16.53 in) so we decided we could use that size instead to

	save time. 
Fabricate a Solution: Building the Chassis	Started putting together the CAD design above. We attached both parts of the assembly with horizontal REV beams and a few L-Brackets. Most of the robot, however, is attached by pinning a screw through the REV, instead of using plastic brackets and plates.

Programming Accomplishments:

Autonomous	
Construct and Test Prototype: Implement A* Pathfinding Algorithm	Using the array of movable & barrier points (black and white map) we created last meeting, we were ready to implement the A* Pathfinding Algorithm. The initial strategy for **point to point movement** is as follows: 1. View VuMark 2. Localize off of VuMark data (figure out robot x, y coordinates on the field) 3. ****What needs to be implemented**** *Pass robot coordinates into A* Pathfinding Algorithm to receive output for robot to follow* 4. Robot follows the pathing using only encoders – robot is effectively blind to other VuMarks, it only follows encoder instructions 5. Pathing is followed until robot runs out of instructions. In other words, the robot has reached its destination. The following strategy makes two assumptions in order to work accurately: • Localization of the VuMark using Vuforia is consistently accurate no matter the robot position • Encoder measurements in all movements (forward, backward, strafe, etc..) are accurate We implemented the above strategy in Java for our Robot Controller. Here are the results of our tests with the algorithm. **Test Success/Failures of A* Point to Point Movement**

Test type	Results
1 – Straight on Mars VuMark, go to Rover VuMark	Successful global alignment to Rover, successful movement to Rover
2 - Slightly to left of Mars VuMark go to Rover VuMark	Successful global alignment to Rover, successful movement to Rover
3 - Slightly to right of Mars VuMark, go to Rover VuMark	Crashes with ArrayIndexOutOfBoundsException, has to do with A* Algorithm implementation

Consensus:

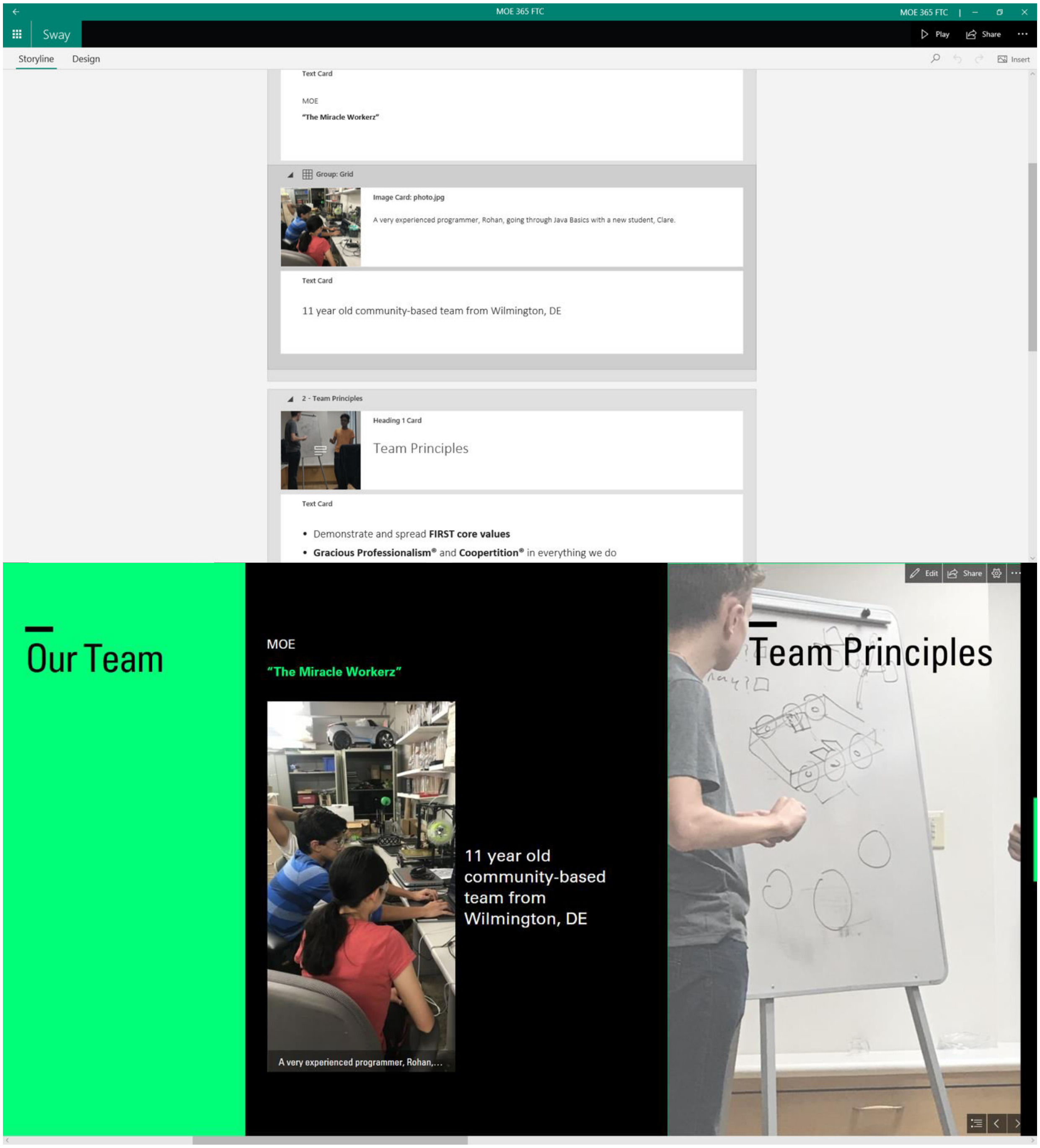
New program is objectively better than the first direct turning implementation. Success rates are better, and the successes are accomplished in a cleaner, more repeatable way. The program crashing only requires additional debugging that is worth time. This confirms that we will go forward with the A Pathfinding Algorithm.*

Non-Technical/Discussion:

1 Week Deadline for New Chassis for Programming – need a better chassis from accurate navigation – Needs to be a higher priority

Judging presentation – Our Project Plan starts our judging presentation today

Although we don't have to, we looked at Microsoft Sway and explored its features to see if it would be good for our judging presentation.


MOE 365 FTC
Sway
Play
Share
Storyline
Design
Insert
Text Card
MOE
"The Miracle Workerz"
Group: Grid
Image Card: photo.jpg
A very experienced programmer, Rohan, going through Java Basics with a new student, Clare.
Text Card
11 year old community-based team from Wilmington, DE
2 - Team Principles
Heading 1 Card
Team Principles
Text Card
• Demonstrate and spread FIRST core values
• Gracious Professionalism® and Coopertition® in everything we do
Our Team
MOE
"The Miracle Workerz"
A very experienced programmer, Rohan,...
11 year old community-based team from Wilmington, DE
Edit
Share
Team Principles

Date: 10/9/18

Duration: 6:00 PM = 8:30 PM

Tuesday, October 9, 2018 Meeting

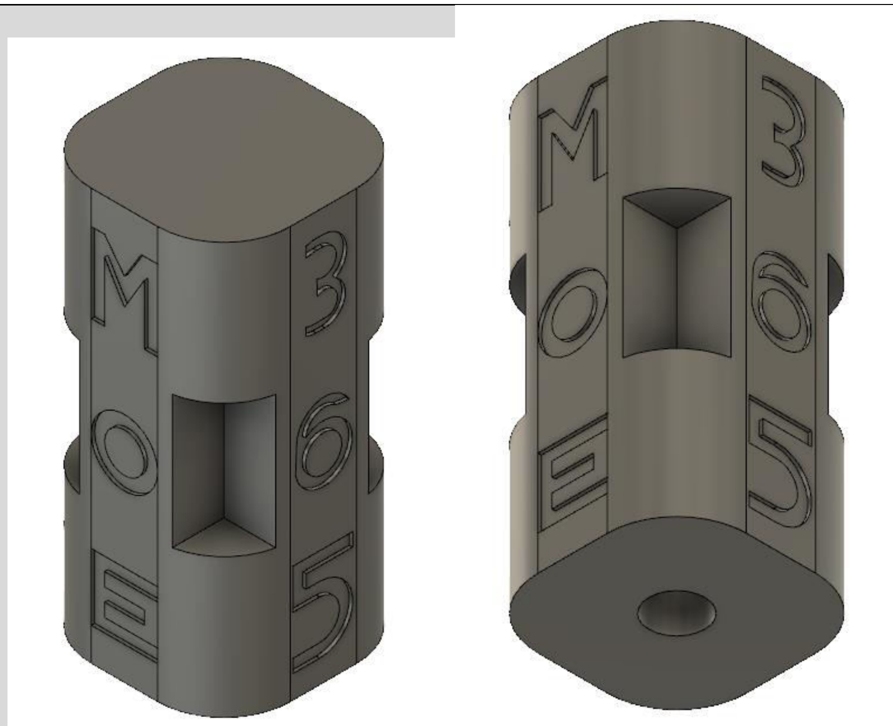
Students:	Rohan	Clare	Jonas	Karthik	Ian
Mentors:	**Mr. Prettyman**			**Andrew**	

Agenda
Previous Meeting Discussion

Tasks:	
Programming	**Team Marker**
Debugging the A* program for motion planning	Print the new team marker that Ian CAD'ed before the meeting Ian

Mechanical Accomplishments:

Team Marker	
Generate Concepts: Totem Team Marker	Ian CAD'ed a new design that is basically shaped as a totem Team Marker The team marker has grips or notches, curved edges on each corner or side of the team marker, and a hole in the bottom.

<table>
<tr><td></td><td>


For this model, you can use the team marker with a mechanism with that dumps the team marker with a server a stick and a grabbing mechanism. This is because there is a hole on the bottom and the gripping/notch areas.

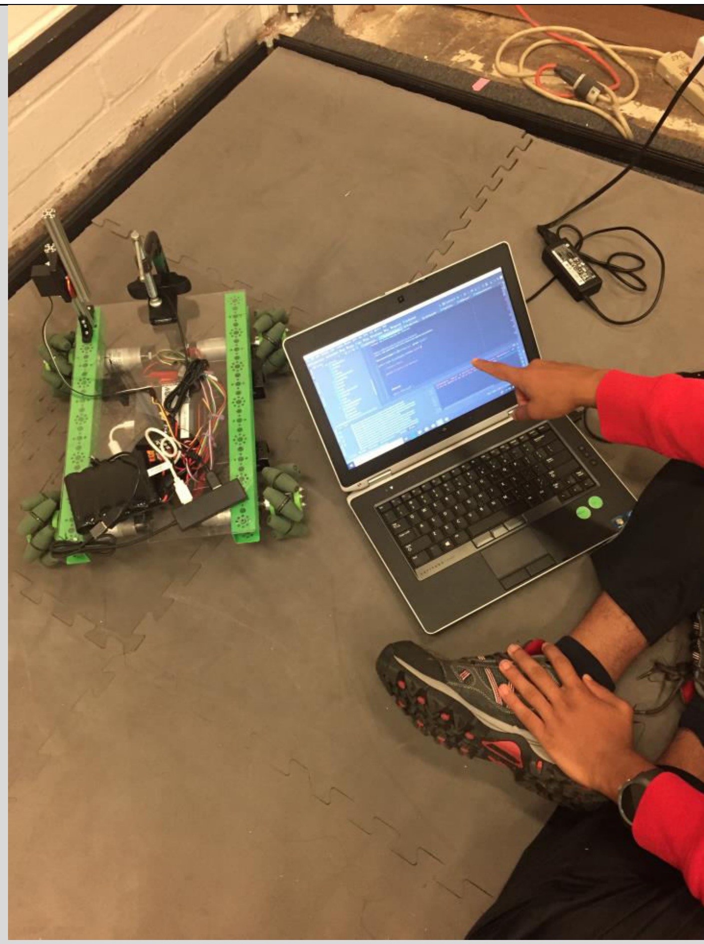
It might help with stability for when it is dropped or put into the team depot.
</td></tr>
<tr><td>Construct Prototype: Totem with indents and hole</td><td>

- Ian took the CAD file and put it Simplified 3D and sliced it in the software.
    - I Sliced it with 2 perimeters, 0.3 mm layer height, 10% infill, and supports
- Then, Ian hardwired the dell computer to the 3D printer.
- Ian took out the Black Petg filament out of the extruder and then put in a new role of green Petg filament.
- Ian then started a print of the team marker and I had tape for adhesion for the print to the bed
- But the printer was printing the first layer of the print weird so I stopped the print.
- Ian and Andrew took the tape and the print Ian stopped and then put glue on the printer bed.
- Then, Ian started the print again and it printed the first layer really well.
- Ian checked how the print was doing a few times through the rest of the meeting.
- At the end of the meeting, Ian was checking the print and the printing interface and he accidental push the emergency stop put on the printer
</td></tr>
</table>

	control interface on Simplified 3D. ◦ Ian did not start the print again because It was the end of the meeting and he will start it next meeting.

Programming Accomplishments:

Autonomous	
Evaluate: Test and identify ways to improve A* Pathfinding Algorithm	After discussing and creating our A* pathfinding algorithm last meeting, Rohan, Jonas, Clare, and Karthik continued to test and debug the program. We discovered several sources of error for the program, including some we discovered in the last meeting. Some errors were: • The robot “thought” that it started in an illegal location; I.e. that it was touching one of the barrier points from the black and white map. • At the moment when the program was run, the robot was not immediately able to identify a Vumark. This meant that the robot was unable to localize and resulted in the program crashing. • In the A* algorithm, we represented the robot as a point, not a shape. This meant that the middle of the robot was following a barrier-free course, but the rest of the robot was knocking into illegal barrier points. To solve this, we gave the robot a radius so that the pathfinding algorithm would view the robot as a circle not a point. This will account for the overall size of the robot. • With a radius that was set to a value greater than 5.5 localized units (11 inches), the robot was sometimes unable to calculate a path that did not hit any illegal barrier points. This would cause the program to crash.

	 We have made significant progress on the A* algorithm and will need to keep working on solving these errors. We will continue debugging and testing next Saturday.

Non-Technical/Discussion:

Ian used the packing list he made to start packing for the outreach event on Saturday. He was looking for the items he needed for a small outreach event and put it into a crate box. There were a few things that needs to be packed but he can do them on Saturday.

Date: 10/13/18

Duration: 9 AM – 2;30 PM

Saturday, October 13, 2018 Meeting

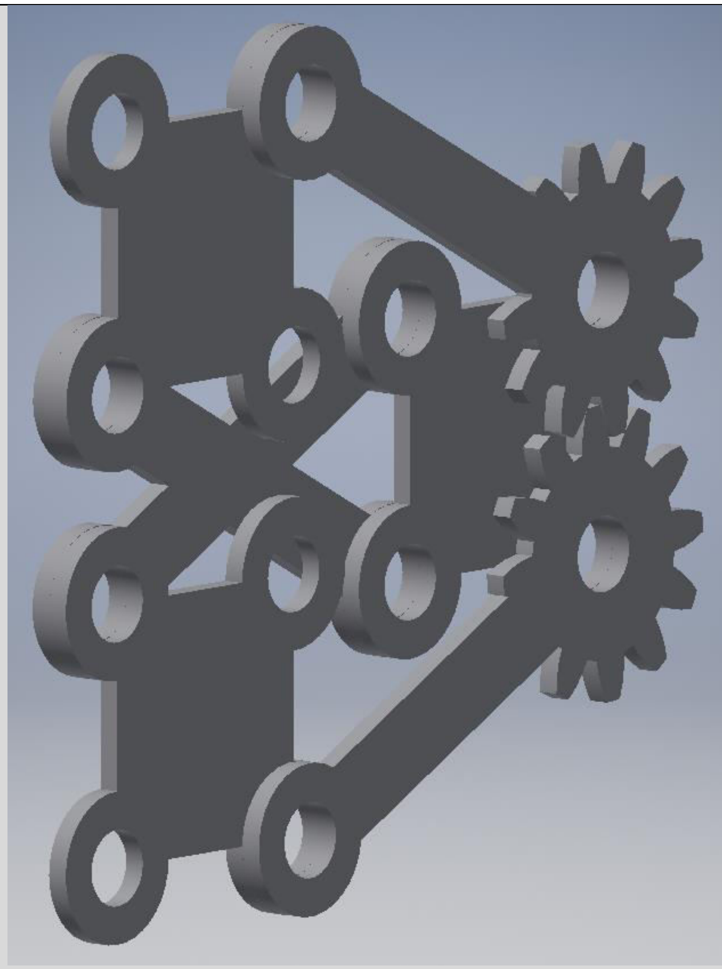
Students:	Connor	Ian	Patrick	Bryan	Rohan	Paige	Clare	Karthik
Mentors:	**Mr. Prettyman**	**Zach**	**Arnav**					

Agenda
Previous Meeting Discussion

Tasks:	
Lifting and Latching (LLMS)	**Autonomous**
Design the Lifting and Latching Management system	Improve programming autonomous pathfinding

Mechanical Accomplishments:

Lifting and Latching (LLMS)	
Develop a solution: LLMS CAD	Zach and Connor began to CAD the lifting and latching management system based on the team's designs.

Programming Accomplishments:

Autonomous	
Evaluate: Discuss possible improvements for A* algorithm	After constructing part of a field in the conference room, Rohan, Clare, and Karthik set up Vumarks and tested the robot's ability to maneuver around the field. We worked on debugging the code and eventually ran several successful tests. However, we identified one central flaw of the program: • The robot was only localizing once – at the beginning of the program when looking at a Vumark. Then, the robot would only be able to use encoders to navigate to its destination. This meant that the robot could not consistently reach its destination with reasonable accuracy. • We wanted to improve the accuracy of the program by localizing and recalculating a path every time the robot was able to see Vumark.
Tweak: Test and improve A* algorithm	Keeping this in mind, we then tried to alter the program to use this path: 1. View VuMark 2. Localize off of VuMark data (figure out robot x, y coordinates on the field) 3. Calculate path that does not move the robot into the vicinity of any

	obstacles 4. Robot follows the pathing using only encoders – until it sees another Vumark 5. Localize off of new VuMark data 6. Recalculate path using new localization position 7. Repeat steps 4-6 until the robot has reached its destination We were unable to finish this improvement but will continue to work on it during future meetings.

Non-Technical/Discussion:

Put more priority on the hanging mechanism because it is behind

Autonomous and chassis are on-track

***No electricity at the lab we are not allowed access* (basically lost a week of meetings)**

Created new folder for the season: Complete Entries, Incomplete Entries, and Printed Entries

- **Used to keep track of meetings and have a more efficient workflow**

Created Outreach Management to keep track of unwritten outreaches

10/13/18

Outreach Management (created 10/13/18)

Outreach	Assigned to	Status
Makerfest (Philadelphia)	Jonas	(10/13/18) Not Started
Hagley Museum	Ian	(10/13/18) Needs Paragraphs
Dover Public Library	Twins	(10/13/18) Needs Details
History Museum	Connor	(10/13/18) Complete
Gravity Event	Katy	(10/13/18) Complete
End of Season Social	Paige	(10/13/18) Not Started
California Summer Program	Rohan	(10/13/18) Not Started
DigiGirlz	Twins	(10/13/18) Not Started
Brandywine 100 Library	Connor	(10/13/18) Complete
Internship Cern	Rohan	(10/13/18) Not Started

This document is used to keep track of the undocumented outreaches prior to October 10th, 2018. If you worked on a document, update status and include date.

Date: 10/16/18

Duration: 6 PM – 8:30 PM

Tuesday, October 16, 2018 Meeting

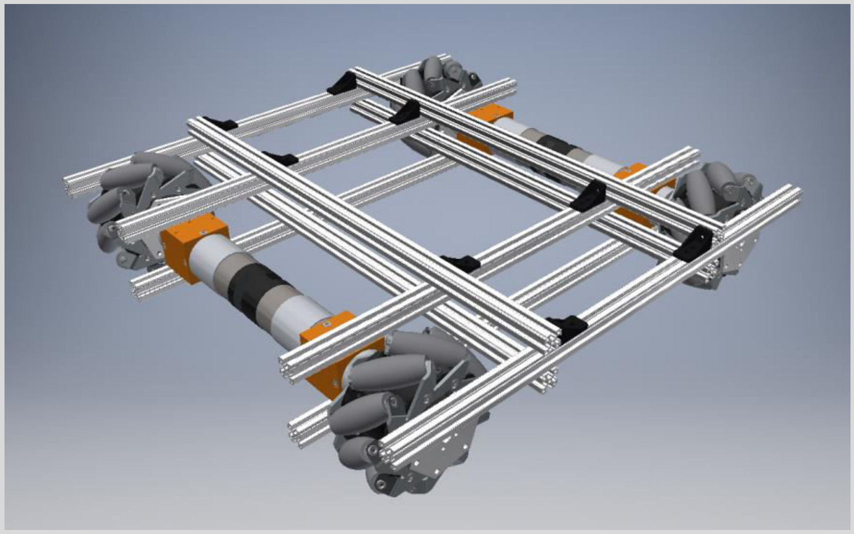
Students:	Patrick	Bryan	Connor	Ian	Rohan	Katy	Jonas	Paige	Clare	Marcus
Mentors:	**Mr. Prettyman**			**Mr. Price**				**Dave**		

Agenda
Previous Meeting Discussion
STIMS
laware Innovation Week
Duel on the Delaware
Game Manual 1 Review (Awards)
Team Goals
Project Planning Review

Tasks:		
Chassis	**Programming**	**Team Marker Mechanism**
Work on chassis design in CAD Connor	Split up into continuing A* algorithm and Mineral Sampling Create mechanical-component checklist Rohan Clare Jonas	Design an idea for a Mechanism for putting our team marker into the depot Ian Connor Mr. Price

Mechanical Accomplishments:

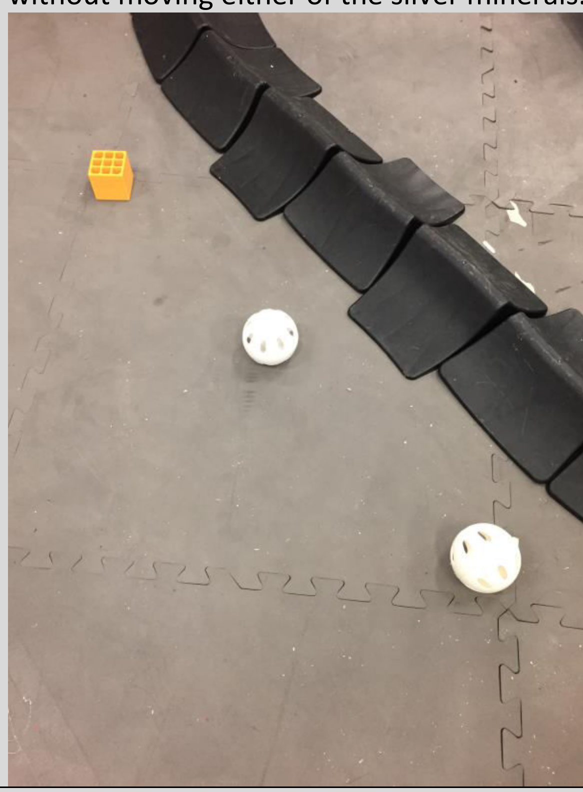
Chassis	
Develop a solution:	Connor Nagle continued working on the CAD for the chassis using 420mm beams. All

CAD with 420mm beams	that is left to do on the Chassis is to double mount the mecanum wheels and attach the electronics. 

Team Marker Mechanism	
Problem: Team Marker Mechanism	Make a mechanism that puts out the team marker into the depot.
Generate Concepts: Team Marker Mechanism	I knew for this mechanism would have a servo, a servo horn, and a tube, pipe, beam, or something else attached to the servo horn. I just need to figure out how to mount the piece that will be used to put the team on to hold it and dump it. The basic sketch of this mechanism is: Connor, Ian and Mr. Price were talking about what to use to be the object to put the team marker on. • Ian thought it should be something round like a PVC pipe, a metal tube or a rev beam extrusion. • Connor said that an axle would not work because you would need to drill a hole in it. But I said that would not work anyways because the hole in the team marker Cad has a 0.8 inches diameter. • Mr. Price said that we could use a rev extrusion beam or a piece of metal that has holes in it. • Mr. Price and Ian decided to use rev extrusion beams.
Create Prototype: Team Marker Mechanism	Mr. Price and Mr. Ian were measuring how tall the team marker mechanism with the servo needs to be with the height of the Team marker • They decided that that they can use a 6 in extrusion to lift up Team marker mechanism and • We also decided a 6 in rev extrusion for the piece to be attached to the servo

	to dump the Team marker. Ian and Mr. Price got two corner brackets, two 6 in rev extrusion beams, a rev servo, a rev servo mount, and 4 hex screws and 4 lock tight nuts. Then Ian mounted a rev extrusion to the robot with two corner brackets. Ian talked to Rohan to see if the direction of the mechanism makes a difference but, Rohan said that it does not matter. I did not get to building the servo mechanism that meeting.

Programming Accomplishments:

Autonomous	
Define Problem: Mineral Sampling Mission	The programming team discussed the mineral sampling mission, which requires the robot to identify the positions of the two silver and one gold mineral. Then, the robot will have to knock the gold mineral completely off of its starting location without moving either of the silver minerals. 
Generate Concepts: Brainstorm ways of "seeing" minerals	In order to complete the mineral sampling mission, we decided to use a computer vision library such as OpenCV or Doge CV. This software will allow us to take a picture using the phone camera or webcam, analyze it, and identify the position of each mineral. Using this information, the robot will select an autonomous path to follow for the remainder of the autonomous period. We discussed the pros and cons of using either OpenCV or DogeCV.

	Pros:	Cons:
OpenCV	• Has been tested by more people (over 14 million downloads) • More versatile	• Not specialized for FTC use • Not preloaded with minerals
DogeCV	• Developed by an FTC programmer specifically for team use • Already has sample code which would provide starting point	• May take more time to debug • Less stable

Using this information, we decided to first try DogeCV.

Tweak: Test and improve A* Pathfinding Algorithm	We continued to test and debug the A* algorithm. We ran into several issues but continued to improve the stability and versatility of the program.

Non-Technical/Discussion:

Several teams – we're being asked if we can compete for fun – should be a good event and local - (November 4, 2018)

- Five hours on Sunday afternoon
- The day after the Independence Outreach

No meeting next Saturday – Duel on the Delaware

- We should understand why we're there
- Rohan is helping Andrew Szeto with a seminar
- Make sure we're packed
- **Wear the MOE shirt!!!**

Award Review

- **Inspire Award – The everything award**
  - **Strong Contender in every award**
  - **Ambassador for FIRST**
  - **Positive and inclusive**
    - **Understand your team role**
  - **We are somewhat on track for the criteria of this award**
    - **Notebook is great but needs to be completed**
    - **Robot design is behind**
    - **Outreaches are on track**
- **Think Award – The Notebook award**
  - **Understand Build Design and Underlying Math and Science**
  - **Clear understanding of the design process**
  - **Team's journey**
- **Connect Award – Professional Outreach**
  - **Connection to the science, math, and engineering community**
- **Innovate Award – Creative Robot Award**
  - **Creativeness in robot design – Out of the box thinking**
- **Design Award – Efficient Robot Award**
  - **Balance between form, function, and aesthetic**
- **Motivate Award – Community Outreach**
  - **Outreach towards the community**
  - **Spread the FIRST program with the community**
- **Control Award – Programming award**
  - **"Mastering robot intelligence"**
  - **Use of sensors, vision tracking, etc.**
- **Promote Award – Video Award**
  - **"If everyone was a FIRST student, the world would be…"**
- **Compass Award – Video Award for Mentor**
  - **Nominate a mentor for this award**

Project Planning

- **Write more details for the upcoming events/deadlines**
- **Programmers are on track**
- **Judging Presentation is already started but more work needs to be done**
- **Design Robot – Due Next week – Not on track**
  - **Minerals need a design – still lowest priority, but we still prefer a design**
  - **Hanging Prototype currently being built out of wood to see if design is viable**
  - **Not too much is in CAD**

        - Chassis
        - Scissor Lift Mechanism
- Shirt Design
    - Need to check if NASA design is okay
    - Several designs have been made
- Team Goal Planning
    - Must be S.M.A.R.T
        - Specific – Must be clearly define the goal
        - Measurable - Must be a countable goal with evidence of progress of the goal
        - Attainable – Must be challenging but still possible
        - Relevant - Must pertain to the Relic Recovery Game and other events in the season
        - Timebound - Deliverables with a target date
    - Our priorities should be alligned with our goals
    - Goal Planning:
        - 2 Outreaches a Month (Average) from the end of last season to the end of this season
            - Tend to do more outreaches in the summer, so a monthly goal is a bit difficult
            - We have to keep searching for them, but if we're well known, people can come to us
            - We need more people to do outreaches
            - To increase relationships within the community and spread the FIRST program
                - Help serve underserved communities to expose opportunities to all
        - Procure 2 new sponsor this season
            - Increase relationships with the professional community
            - Gain sponsorship money to support the team
            - Local ties to smaller, Delaware organizations
            - Tiered Reward System
                - Like Patreon – the more money given, the higher the benefit for the organization
        - Everyone must know their team role at meetings, competitions, and outreaches after the first qualifier and onwards

- **Each team member must contribute to the success of the team – knowing your team role will help maintain a positive and inclusive team environment as well as increasing efficiency**
- **Nominated for a judged award in 50% of our competitions and win a judged award at 25% of our competition**
  - **Ensures that we have a focus that is outside just our robot**
  - **Demonstrates consistent excellence in all fields**
- **Implement a new engineering notebook update process**
  - **Create templates for ease of use**
  - **Each sub-team is responsible for keeping their status updated in the notebook**

- **We should create more S.M.A.R.T personal goals that are trackable throughout the season**

  Helpful as a life skill

  Tracks personal growth

- **Team A and Team B Driving Teams**

Date: Tuesday, October 23, 2018

Duration: 6.:00-8:30 PM

Tuesday, October 23, 2018 Meeting

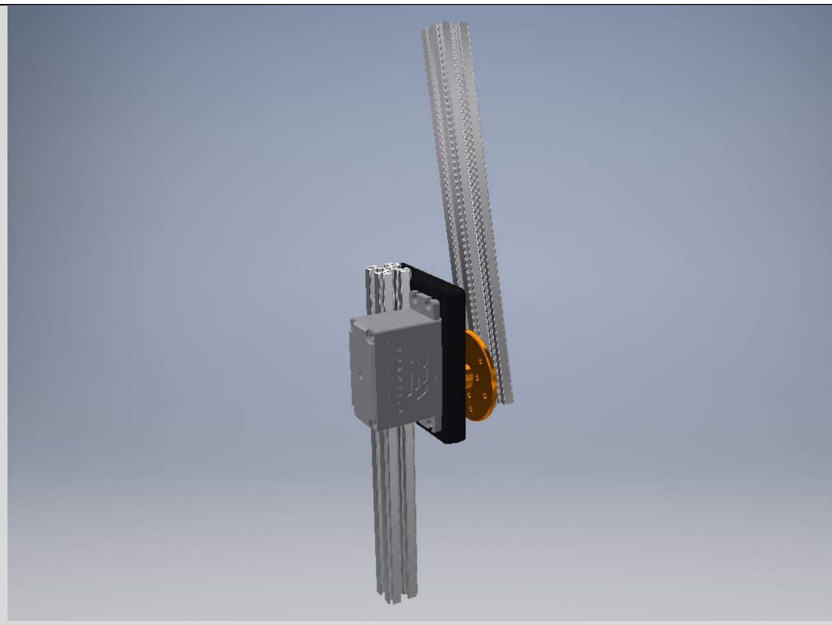
Students:	Connor	Ian	Marcus	Bryan	Patrick	Jonas	Clare	Paige	Rohan	Katy	Karthik
Mentors:	**Mr. Prettyman**			**Mr. Price**				**Dave**			

Agenda
Discuss Duel on the Delaware
scuss Team Goals

Tasks:		
Programming	**Team Marker**	**Team Marker Mechanism**
Start looking into mineral detection and make sample autonomous path	Drill hole in the first Team marker prototype 3D print the 2nd team marker prototype.	Start testing the Team marker mechanism

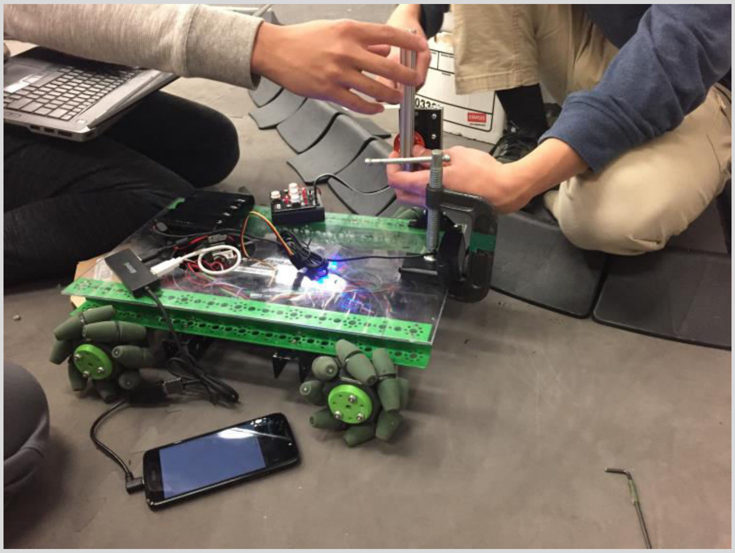
Mechanical Accomplishments:

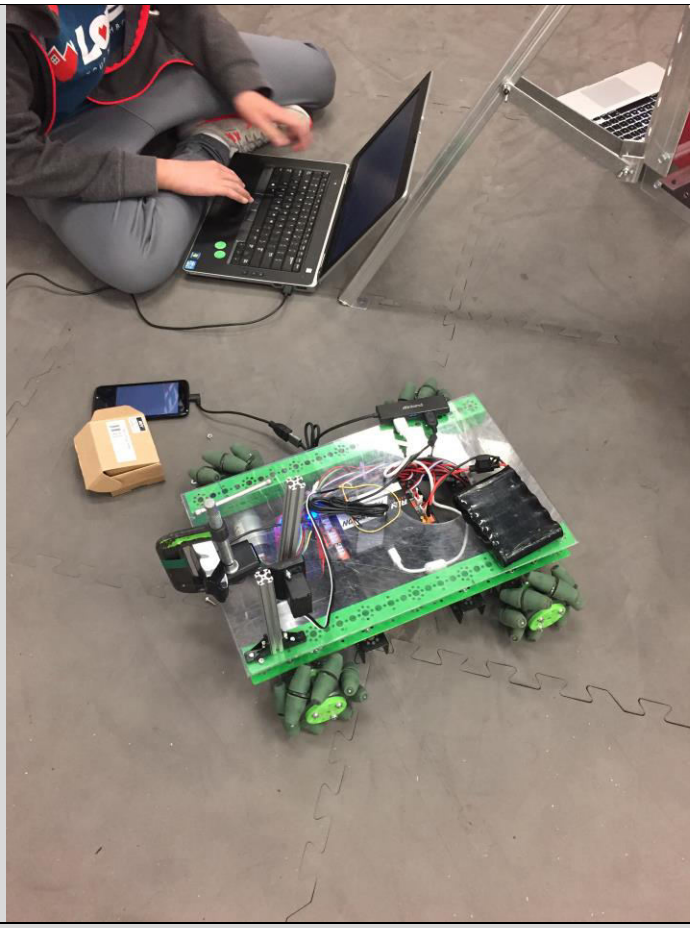
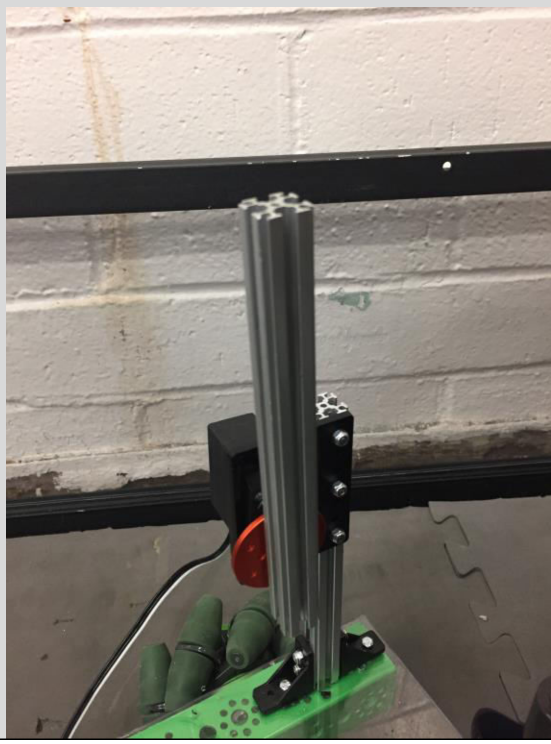
Team Marker Mechanism	
Develop a solution: CAD the Team Marker Mechanism	Connor wasn't at Duel of the Delaware when Ian designed and built the team marker mechanism, so he CADded it during this meeting.



Team Marker	
Tweak: Drill a giant hole in the middle of the team marker	Ian and Marcus drilled a hole in the team marker so they can put it on a REV extrusion on a servo that drops the team marker. While doing this, they used different drill bits to figure out a good size so it could fit. They had to put the hole more to the end rather than the middle so the rev extrusion beam could drop down easier rather than it being stuck to it. When drilling we had to slowly increase the size of the drill bit to avoid cracking the 3D printed prototype. While in the process of this the drill press was to slow so we later had to put the bigger drill bits on a drill so it would spin faster and avoid the 3D printing from cracking into little pieces. It was a good successful start but next time we will choose to print a hole rather than drilling it to avoid massive damage to the 3D printing of the Team Marker. Then, they started to test the Team marker Mechanism with the Team Marker with the drilled-out hole.
Creating Prototype: Totem Team marker with indents and 3 Holes	Ian added two holes to the bottom of the team marker, one on each side of the original hole. He put them in for test which placement of the hole works the best. He also changes the hole depth for 2 inches to 1.5 inches. Ian and Andrew started off a print for the second prototype for the team marker at the end of the meeting.

Programming Accomplishments:

Autonomous	
Construct and Test a Prototype: Autonomous path	Jonas and Clare got more hands-on coding experience while trying to program a sample autonomous path. We used the pathfinding algorithm to map out one of the possible routes.  As part of our autonomous program, we worked on setting up the DogeCV software. This will be used to identify the gold mineral for Mineral Sampling. We ran into some bugs in the downloading process but will continue to work on it at the next meeting.

	
Construct and Test a Prototype: Team Marker Servo	We also attached a servo with a stick to the programing chassis so that we can program the robot dropping off the team marker. The team marker will have a hole in the bottom, and when the servo rotates, it will fall off into the team depot. We programmed the servo to move so that we could demonstrate this concept to the rest of the team. 

Non-Technical/Discussion:

Duel on the Delaware Outreach

Details can be found in the Duel on the Delaware outreach entry

Team Goals Discussion:

2 Outreaches a Month

No criticism on the magnitude of this goal

Goal Time changed to End of last season to end of this season (counting summer outreaches)

Procure 2 Additional Sponsorships

Other teams said some of their sponsorship were local and other teams also have done the tier reward system – Viable Goal

Win 50% and Nominated for 75% Judged Awards

Goal increased by 1 Nomination and 1 Win for judged awards

Everyone must know their role...

No criticism for this goal

Documented Notebook Process

No criticism for this goal

Date: 10/27/18

Duration: 9:00 AM – 2:30 PM

Saturday, October 27, 2018 Meeting

Students:	Patrick	Bryan	Ian	Connor	Karthik	Clare	Katy	Jonas	Paige
Mentors:	**Mr. Prettyman**	**Tobi**							

Agenda
Discuss Previous Meeting

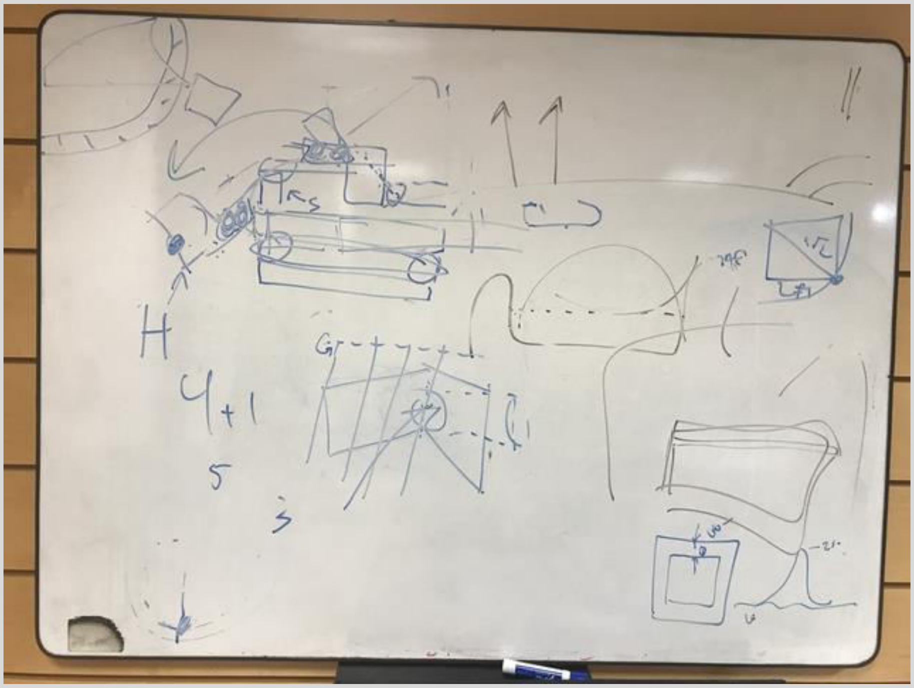
Tasks:		
Chassis	**Autonomous**	**Team Marker**
CAD with everything mounted on it Connor	Work on mineral identification using DogeCV Clare Jonas Karthik	Check How the second team marker printed. Start test the Team Maker Mechanism with it. Ian Marcus

Mechanical Accomplishments:

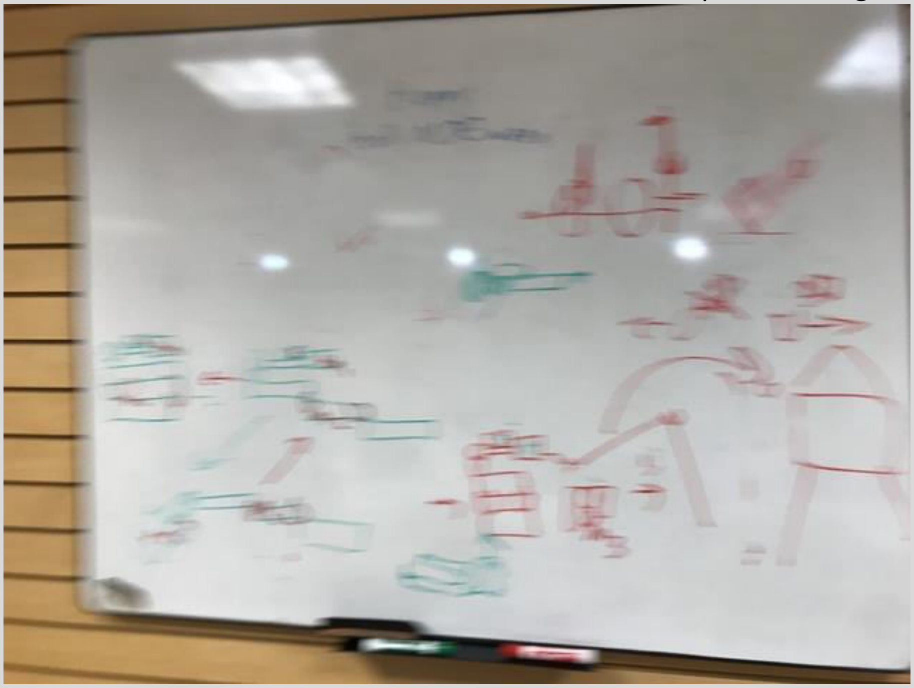
Chassis	
Develop a solution: Continue Chassis CAD	Connor Finished mounting the wheels on the Chassis in CAD. He is beginning to import the other mechanisms and figure out how they will fit on.

MMS	
Generate Concepts: Harvester on linear slide	We felt that the mechanical side was a bit behind schedule so we quickly narrowed down designs and kept discussion fast-paced • We did not want to get hung up on a minor detail that we can fix later in the season We still wanted a design that would be upgradable (with sorting mechanisms and other add-ons) so we did not want it to be restrictive

We have already discussed that we should NOT go into the crater to pick up minerals so we quickly sketched out a chain driven linear slide with a small harvester mechanism on the end



We also discussed how we would raise the minerals up to the Cargo Hold



Picture is very blurry but it shows the explanation of the chain driven linear slides on the left and also showing different ways to get the minerals into the cargo hold on the right. It also shows an idea of passive sorting at the top

We chose to not have a sorting mechanism but consider one in the future – may or may not implement depending on performance in competition

We discussed whether it would be faster to choose not to sort in the future; however, we dropped the topic as we needed to do quick brainstorming and worry about details when we reach our tweaking stage.

Team Marker

Creating Prototype: Totem Team Marker with holes (with Problem)	Ian came to the lab after the team meeting to find that the print of the second prototype of the Team Marker, that he printed on Tuesday's meeting, failed. • It looked like the printer printed the team marker print until a little after starting the three holes next to each other. Then something happened and then the printer started to print a ball of detached filament. • Ian thinks that this was caused by the edges and corners of the print that were stuck to the bed warped off the bed. This caused the print to not stick to the bed, causing the extruder to print that "hairball" of filament.  Then, Ian thought of solutions to stop the warping from happening • One option was to add a raft to the bottom of the print. This would make the print stick better to the printing bed by adding surface area and helps stop warp. The bad part of this is it is hard to get it off the print. • The second option is to add more glue and print the print like the last time. • Ian choose to do the second option and to retry how the print printed the time before (Now, he regrets this decision) Marcus and Ian start the print and the printer is printing the first layer of the print and it was printing the inside of the print very grisally. They think it was from the filament around the nozzle that was dragging on the print so they stopped it. Then, they cleaned of the nozzle with water to get the filament and other stuff of the printer nozzle. Then, they printed it again and it was printing the first layer perfectly. At the end of the meeting, Ian noticed that one of the sides of the print was coming off or warping off the bed. He asked Mr. Prettyman what to do and he said to let it keep printing. So, Ian left it printing without stopping it.

Programming Accomplishments:

Autonomous

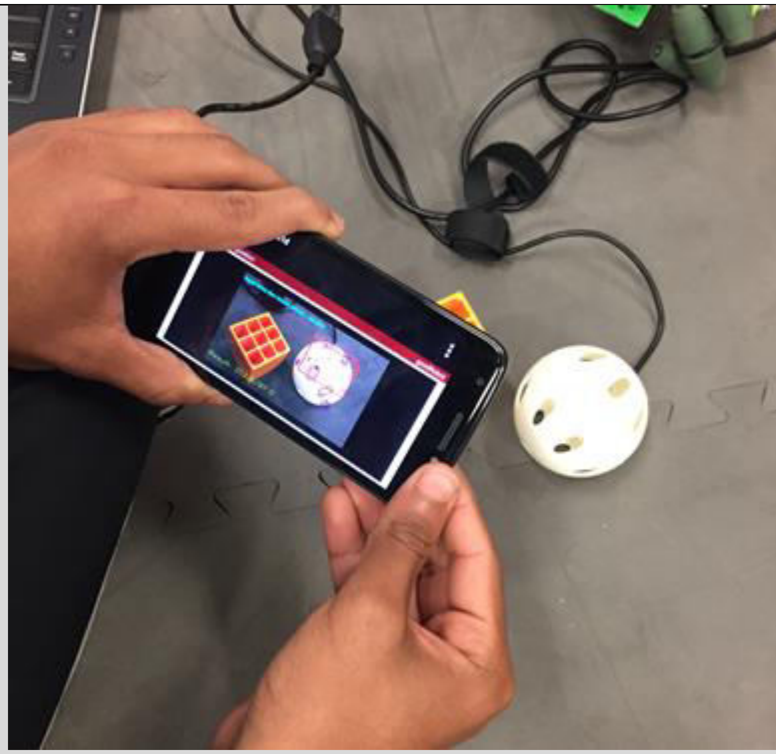
Team Discussion: Progress Update

First, we reviewed our overall programming progress.

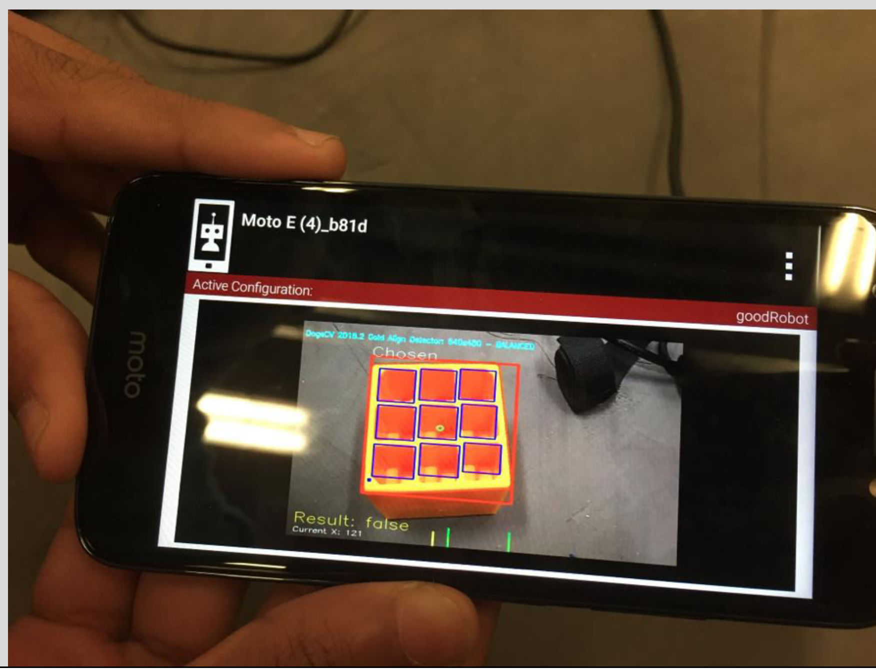
Task:	Progress made:	Remaining work needed:
A* Algorithm	We have written the program, debugged it, and used it successfully to move from one point on the field to the other using our localization system.	We need to review the code and alter it so the robot can localize every time it sees a Vumark. We also need to program the robot to turn rather than use strafing.
Unlatching from Lander	We have discussed where the robot will land and what kind of mechanism will be used.	We need to get a prototype from the LLMS team in order to program the unlatching movement.
Mineral Sampling Mission	**We have decided to use DogeCV to recognize the minerals.**	We need to implement the software and write autonomous paths based on where the gold mineral is.
Dropping off Team Marker	**We have installed and programmed a servo to drop the team marker.**	We need to code this task into an autonomous path, test the prototype, and decide on a final solution.

Construct and Test a Prototype: Using DogeCV for Mineral Identification

Clare, Jonas, and Karthik were able to successfully get DogeCV working on the phone camera. The software was able to identify the minerals in the image.



We also reviewed the DogeCV code and experimented with the software. We tried to get the robot to turn towards the Gold mineral and to place the DogeCV code within our pathfinding algorithm. We were able to understand more about how the DogeCV software works and plan to use this knowledge while programming autonomous paths in upcoming meetings.



Date: Tuesday, October 30, 2018

Duration: 6:00-8:30

Tuesday, October, 30, 2018 Meeting

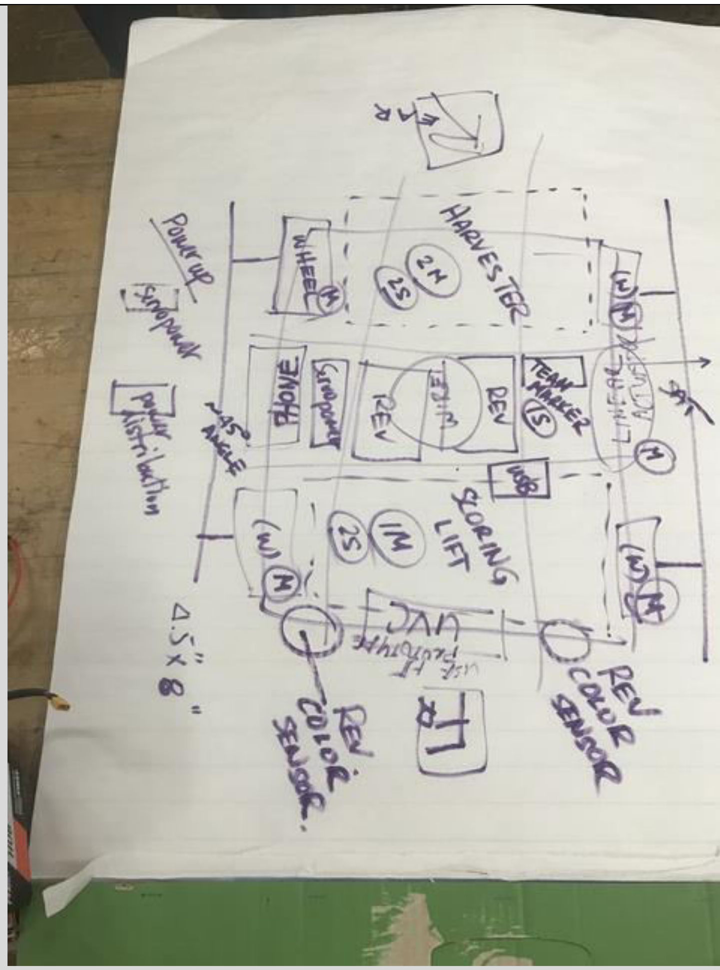
Students:	Connor	Ian	Bryan	Patrick	Rohan	Clare	Jonas	Karthik
Mentors:	**Mr. Prettyman**	**Andrew Szeto**	**Dave**				**Tobi**	

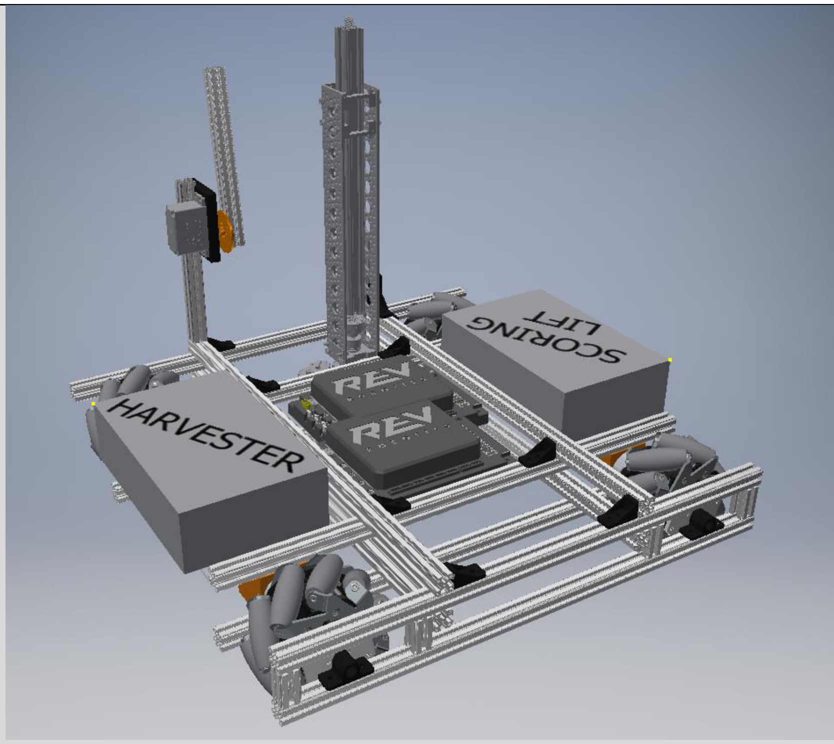
Agenda
Discuss Previous Meeting

Tasks:			
Programming	**MMS**	**Team Marker**	**Team Marker Mechanism**
Use DogeCV to complete the Mineral Sampling mission.	Continue planning and start prototyping Patrick Bryan Rohan	Check on how the Team marker printed	Continue Testing the team marker mechanism with programmers.

Mechanical Accomplishments:

Chassis

Develop a Solution: Plan out entire chassis	 Counted all the Motors (labeled as [#]M) and Servos (labeled as [#]S) to make sure we do not have more than 8 Motors and to see how many servo extra servos we can use Planned out every part to see designate size constraints Decided to include a Power Up Module to increase the speed of the servos
Develop a Solution: Sectioned CAD	Connor finished most of the chassis. He started putting other mechanisms on, and used rectangular placeholders for the mechanisms that are not made yet.



Fabricate a Solution: Polycarbonate plate	Cut a piece of polycarbonate to go in the center of the robot. This keeps the motors from bending inwards and gives mounting areas for the electronics. We drilled a giant hole through it for motor wires to go from under the robot to the REV Expansion Hub

MMS

Generate Concepts: Adaptable design

Decided we do not necessarily need to worry about sorting/scoring both elements in the first competition (there is enough of one element anyways)
But we still need to plan for an adaptable design so we do not need to rebuild to increase function– just add.

- This means we need to plan for the future but not necessarily implement the design immediately

There are three general different places to sort

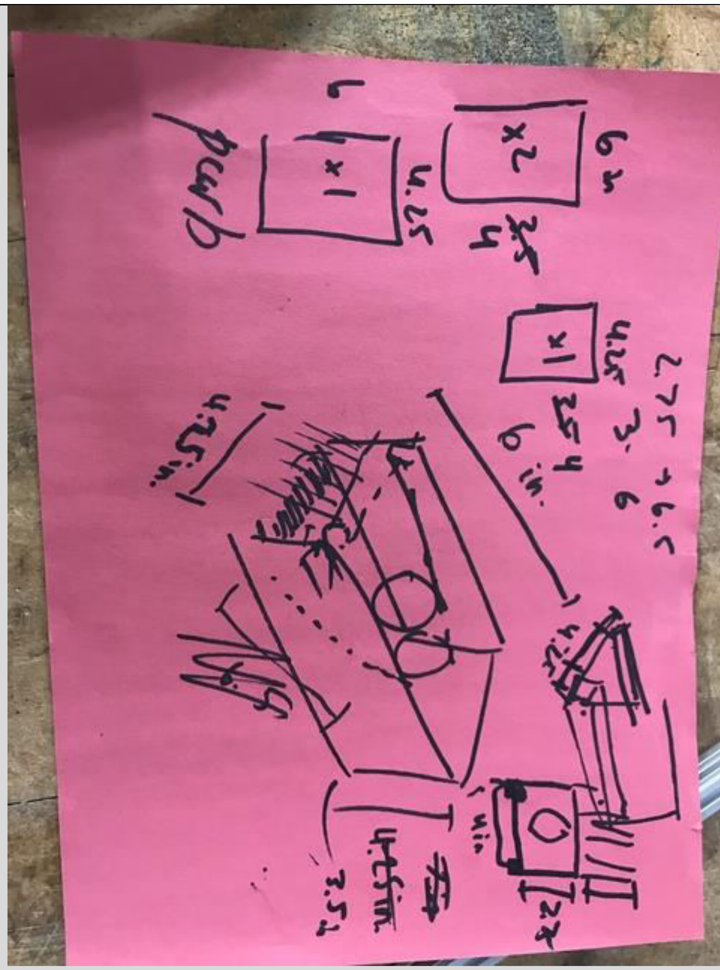
1. The Harvester
2. Within the Robot
3. Right Before scoring

Type	Explanation/Pros & Cons
1	We could sort at the harvester by being only harvest one type of mineral in the crater. This means we can keep the harvester on in the crater and know that we will have two of the same mineral. This makes scoring easier because the driver only has to go the one side of the Rover.
2	If we Sort within the robot, we can collect any two minerals and it can sort it while we're moving out of the crater. This makes collecting more efficient but scoring may be more

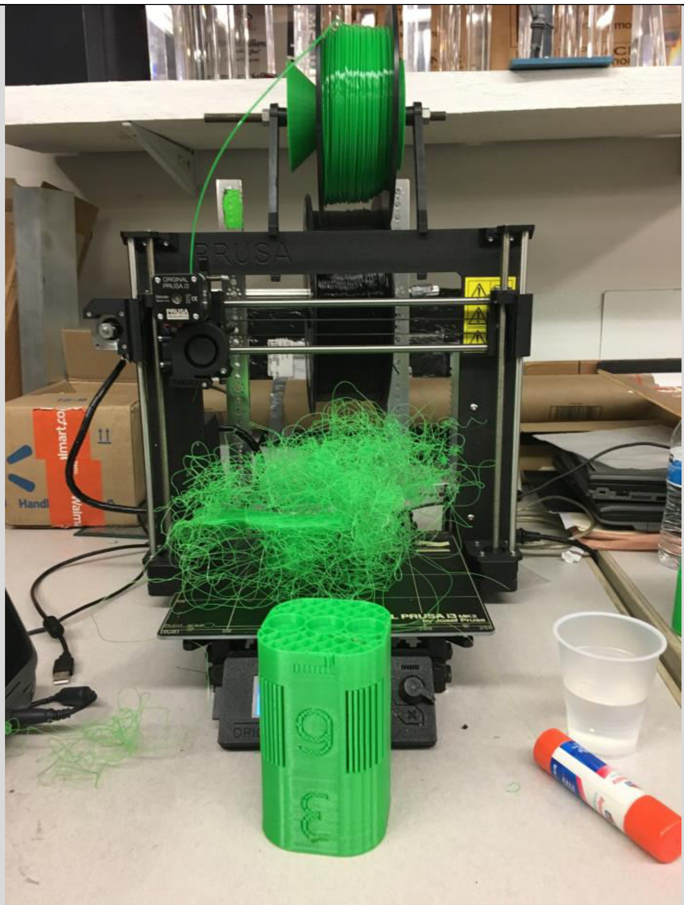
	difficult because it would require more internal movement of the mineral inside the robot for it to sort into the correct place.
3	Sorting right before scoring means that we could organize the balls as they go into dispensing and change the way we score depending on the type of mineral we have. This means we would be able to use one mechanism for scoring and then it changes itself (maybe by power, maybe by shape) to be able score from a certain position

We decided to go with Type 1 and then Implement some sort of Type 3 Design in the future

- For now:
  - Only be able to harvest one mineral at a time
  - Not having enough minerals is a "good problem to have" because it means we scored a lot of minerals – should not be a big concern for an early competition because many robots may be more or less at the same level
  - Probably go for gold minerals because there are more of them in the field than silver
  - No other sorting – just pass to lift and score because it would only be one mineral
- In the future:
  - Either create another type of filter that is togglable so we can choose which of the two minerals we want to harvest – only need to score at one side of Rover per trip
    - use Type 3 3 Sorter for assisted tele-op so the robot already knows which mineral it has – could implement a dispenser that can score gold from the corner (less driving)
  - Or create a sorter that sorts at the end and let the harvester be able to collect both types of minerals – should be able to score from silver side even if the mineral we are holding is gold (score from the corner)

Develop a Solution: Plan Design for MMS	 Created a rough sketch for the harvester part of the MMS including dimensions
Construct and Test a Prototype	Started cutting out polycarb for the walls of the harvester

Team Marker	
Creating Prototype: Totem Team Marker	Ian comes to the lab and found that the print fail again with the ball of filament on the print and the fail team marker in front of the printer. (This might have been someone moving it off the print bed.) • This print might have failed from warp or the lines of the circles of the holes being printed so close or overlapping or both.



Then, Ian explains to Andrew that the last two prints failed and what he thinks was the cause of the failures.

Then, Ian and Andrew prepared the printer and the print so that the print does not fail. Andrew tells Ian to put tape on the bed.

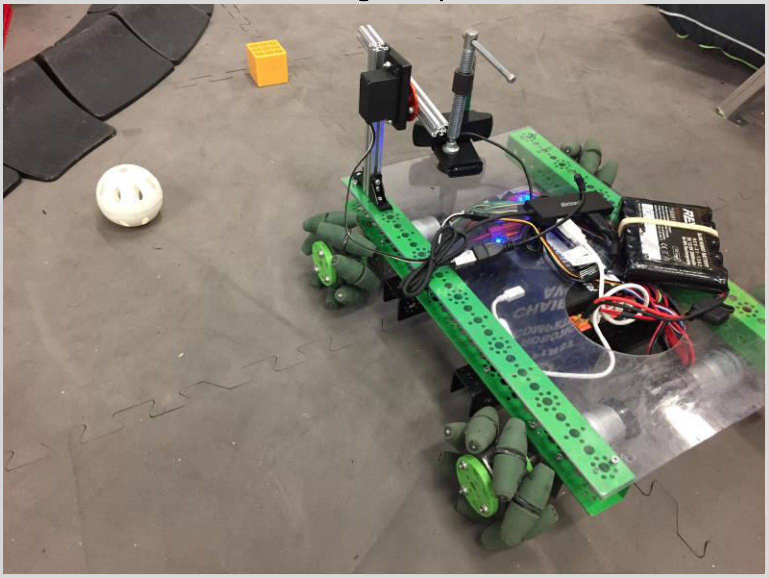
- Ian washes off the glue on the printing bed by using water and heating up the bed to help get the glue off.
- Then, Ian puts blue painter's tape on the bed.
- Then, Ian starts slicing the print of the team marker.
- Ian asks Andrew if the print need a raft and he said you can but it does not need it and it would be hard to get off.
- So, Ian did not put a raft on it.

Then, Ian was readjusting the location of were the print was printing on the printer. After starting printing, it and saw the print was not where he wanted it, he stopped the put it in the center of the print and started printing it. But the extruder was up too high so Ian must have pressed something to make that happen.

He homed the printer a few times and then started printing it again. It was printing good and the extruder was off the printer bed at the right length. He watched the first layer print and then did someing else.

Team Marker Mechanism	
Testing Prototype: Team Marker dropper	Ian worked with Jonas to test the team marker mechanism. Jonas used a servo programmer during the test to test it with a team marker on it. Jonas used the servo programmer to make the servo repeat going from the extrusion beam being up to it being down near the chassis of the programming robot. We tested the team marker mechanism by putting the team marker and letting the mechanism drop it. We saw the when the servo was taking little stops to it descend, it helped the team marker fall of the rev extrusion beam. Then, we tested the mechanism after the programmers programmed it in their code, which did the lowering of the extrusion without little stops and that worked pretty well also.

Programming Accomplishments:

Autonomous	
Construct and Test Prototype: DogeCV Autonomous	Jonas, Karthik, and Clare worked on implementing the DogeCV software into an autonomous program in order to identify the gold mineral. We tried to make a program that followed this series of steps: 1. Use DogeCV and the phone camera to identify where the gold mineral is positioned (right, left, or center). 2. Move the robot into a position where it can identify a Vumark. 3. Using the Vumark, localize using the pathfinding algorithm. 4. Based on where the gold mineral is, follow a path that will knock the gold mineral off of its original space. 
Evaluate: Autonomous Path	This was the result of each step: 1. We were able to use DogeCV to identify the position of the gold mineral.

	2. Using encoders, we were able to program the robot to move into view of the Mars Vumark. 3. We tried to use our pathfinding algorithm to localize, but we ran into an error with the algorithm. 4. The error prevented us from completing the Mineral Sampling mission. We then tried to diagnose the error. • The algorithm was designed to prevent the robot from moving into the crater or hitting the walls around the Field, but the robot was ignoring this and trying to move into the crater. • While the robot was supposed to move efficiently in one direction to reach its destination point, it instead turned erratically and did not move decidedly in any direction. • After a few seconds of running, the program frequently crashed. We will work on debugging and continue to write this autonomous program at the next meeting.

Non-Technical/Discussion:

Cad Laptop – The CAD laptop didn't work at the start of this meeting because the hard drive did something bad. When the issue was fixed, Connor, backed up all the CAD to a USB to make sure he won't lose a file if this happens again.

Date: 11/3/18

Duration: 9:00 AM – 2:30 PM

Saturday, November 3, 2018 Meeting

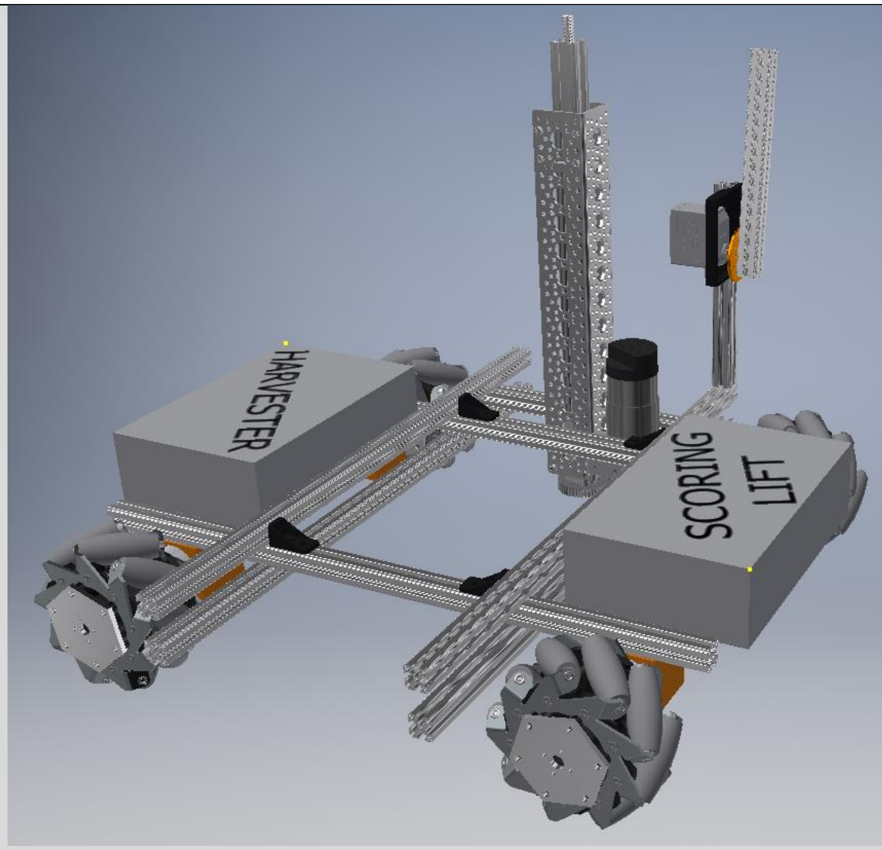
Students:	Patrick	Connor	Bryan	Ian	Marcus	Paige	Rohan	Karthik
Mentors:	**Mr Prettyman**	**Tobi**						

Agenda
Discuss Previous Meeting
ck for Outreaches

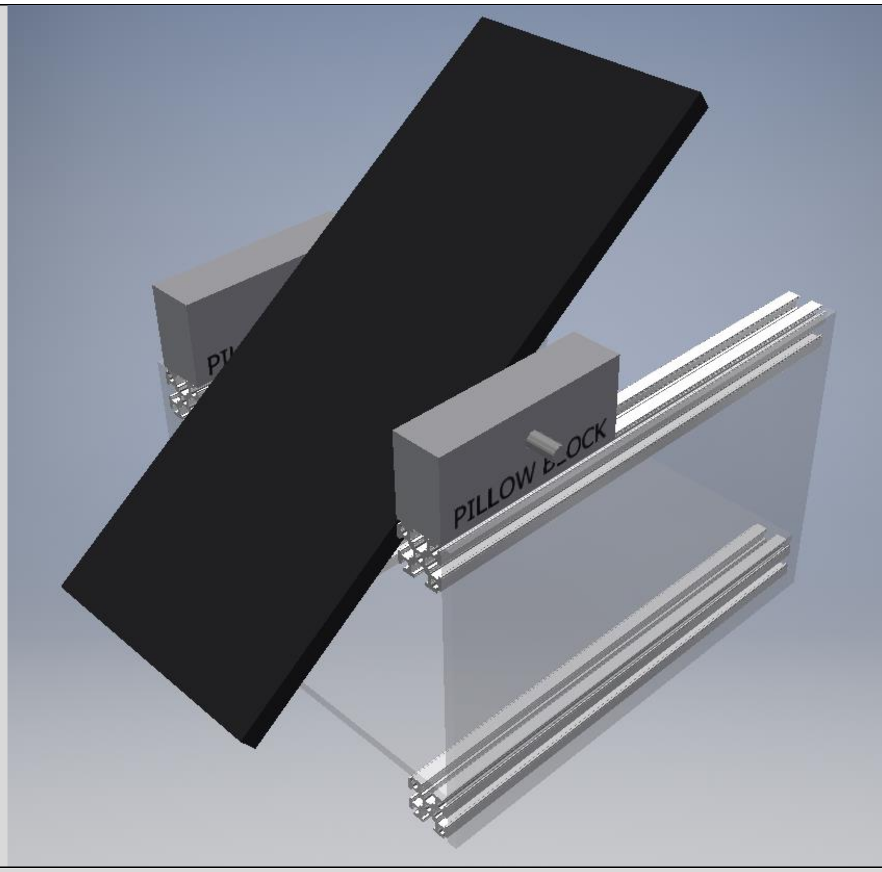
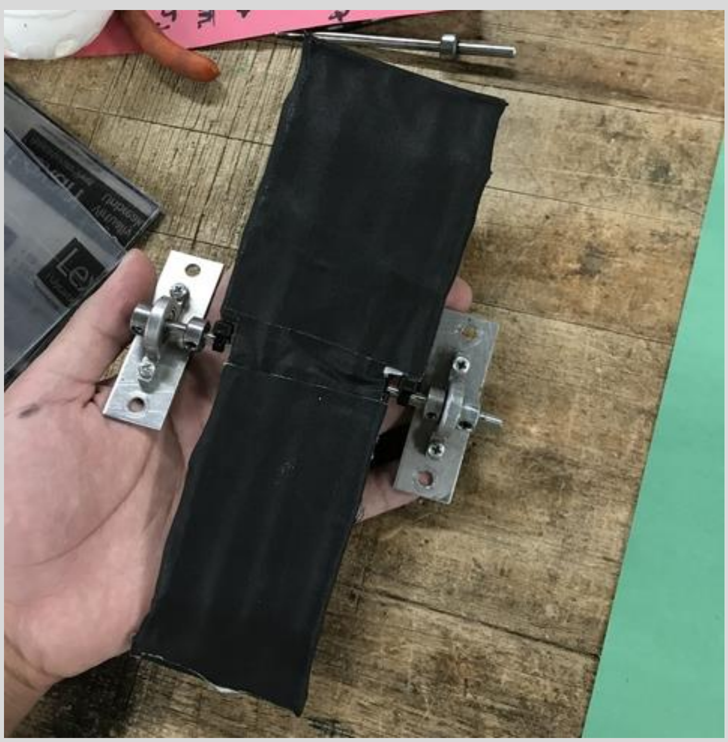
Tasks:		
Programming	**MMS**	**LLMS**
Fix A* Pathfinding algorithm and continue programming autonomous Karthik (Rohan)	Start building the Harvester and Lift Mechanisms Patrick Rohan (Bryan)	Mount the LLMS to the robot Bryan Ian

Mechanical Accomplishments:

Chassis	
Develop a solution: CAD chassis	• Finished creating linear actuator mechanism in CAD • Moved some things around on the Chassis • Our team decided that we do not actually need to double-mount the mecanum wheels. The CAD was updated to match this design of the chassis.

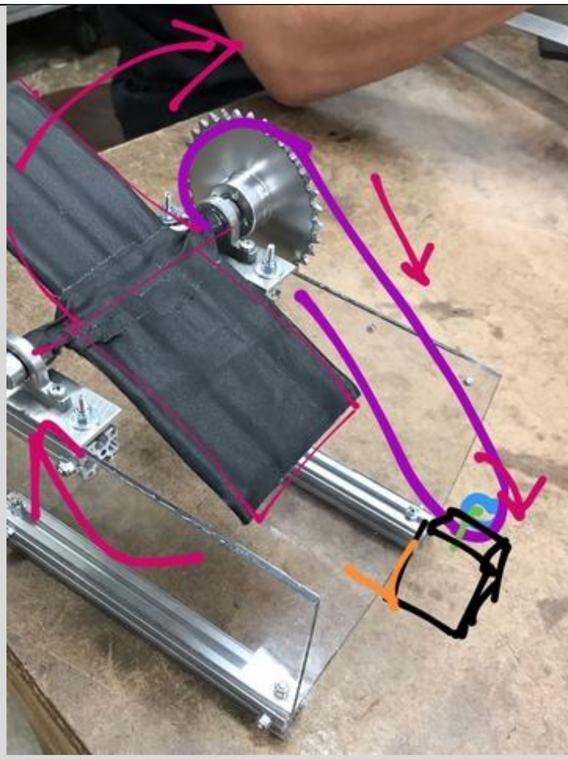
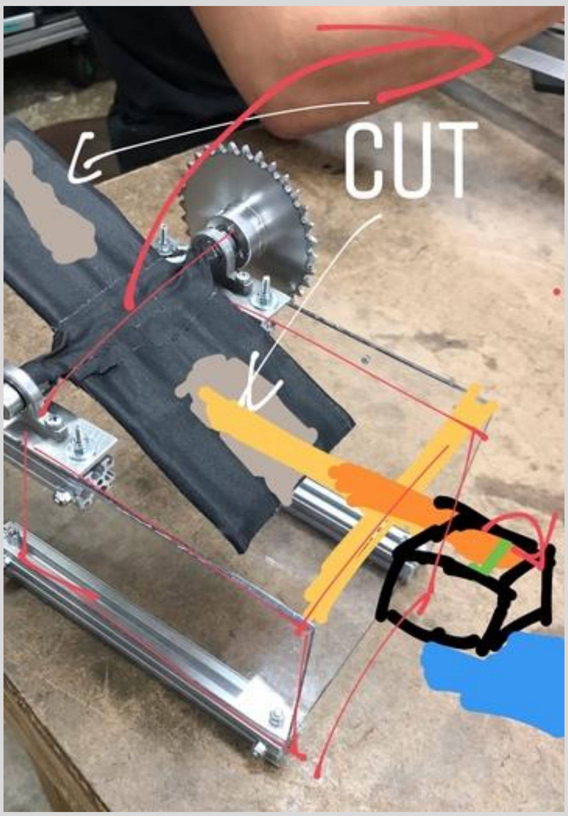


MMS	
Develop a solution: CAD harvester	Connor created basic CAD for the harvester part of the MMS based on Bryan's design. He could not find the pillow block parts that Bryan used so he made his own.

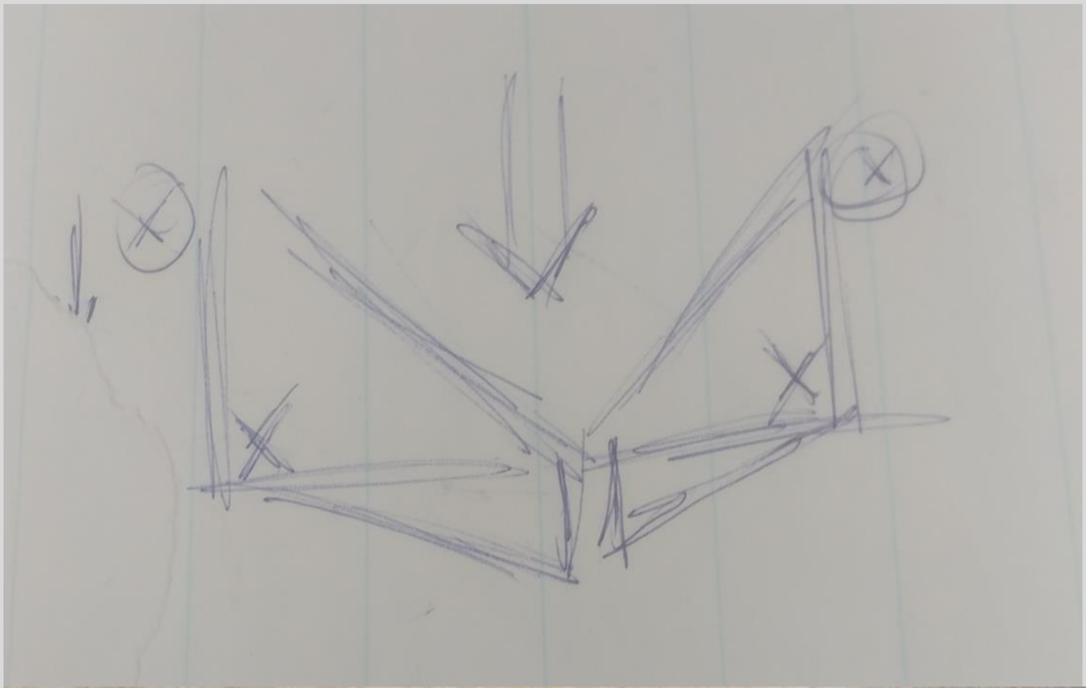
	
Construct and Test a Prototype: Build Harvester Mechanism	For collection, we used Gaff tape around zip ties for a simple solution. We did not want to spend too much time find a perfect design, but we may choose to upgrade later  The next step was to build the surrounding basin for the harvester. We already had polycarb cutting from the previous meeting, so we just needed to drill the holes to so we can screw Rev extrusions and assemble the plates into a rectangular prism

Then, holes were drilled at the top of polycarb, and also into the rev to mount the harvester on to the Rev and the Rev onto the basin

After looking at the completed harvesting module, we wanted to look at how it can be implemented and where to put servos/motors so we can have an idea of what to do in the next meeting.

	 This sketch shows that we wanted a servo mounted to the bottom plate that is chained up to the sprocket of the harvester  This sketch shoes the servo that is going to fold the intake module back into the linear slide, and also something that can keep the blocks from falling out. With that, the harvester would need holes to prevent it from hitting the top.

LLMS

Fabricate the Solution: Mounting a motor	Mounted a motor to the Linear Actuator. Since we don't have the right materials from the Actobotics kit, we drilled two holes in the Linear Actuator so we could attach a motor mount.
Develop a solution: Carabiner	Sketched out the design for carabiner made out of stronger material   This followed the same idea as our prototype and is not only made to be more durable, but easier to score with. The two pieces that open up slope down to a point, which means that, A) Only that little bit needs to be inside of the bracket, which is a lot easier to fit And B) The bracket can easily slide on a steeper curve instead of having to push it all out of the way
Fabricate the Solution: Carabiner	Started building the carabiner

We discussed the issue of a very basic simple machine that we have inadvertently created: the lever.

The two blocks that are keeping the carabiner shut are the most load-bearing blocks, even without the lever. However, looking at the rotating triangles we made, one leg is more than twice the length of the other leg. This means the entire weight of the robot is being applied on the blocks with more than double the force.

We rotated them 90 degrees, in hopes of only needing to bear the load of half the robot.

	 We realized we might run into an 18-inch problem with this rotated design so we decided to keep the leverage against what is preferable, and maybe switch out the block for something more durable next meeting.

Programming Accomplishments:

Autonomous	
Construct and Test a Prototype: Debugging A* Algorithm	The A* pathfinding algorithm was crashing, and Rohan and Karthik did some debugging to discover the source of the error. After realizing that the x and y values were switched, they corrected the issue and successfully solved the problem. The reason the flipped x and y values caused an issue was due to the fact that the flipped values caused the pathfinding algorithm to thing the robot was on a completely different part of the field (in fact reflected over a f(x)=x line across the field). After the corrections were applied, the robot was in its correct place on the field.

Non-Technical/Discussion:

Ian, Marcus, and Paige left the meeting early to go to the outreach at Independence School.

CAD laptop - The CAD laptop stopped working again. This made Connor unable to do CAD for the beginning of the meeting. When we got the laptop working again all the CAD wasn't there. Good thing Connor made backups of most of the CAD on Tuesday. However, he needed to redownload the CAD software. However, after Connor started downloading CAD software Mr. Prettyman found out that the computer was booting from the wrong hard drive and all the CAD was still there just on the other drive.

Date: 11/6/18

Duration: 6:00 PM – 8:30 PM

Tuesday, November 6, 2018 Meeting

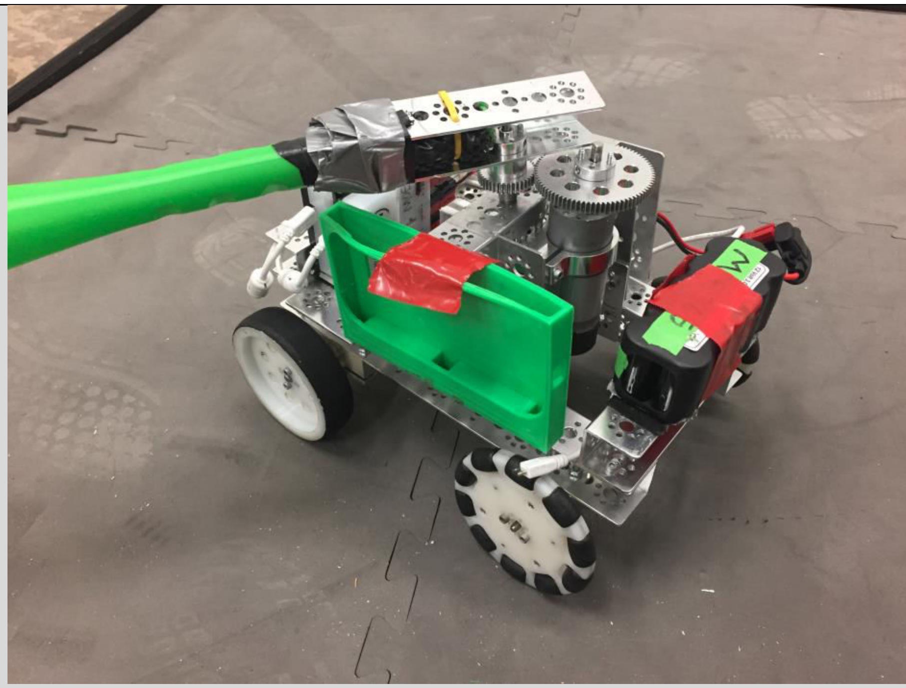
Students:	Patrick	Bryan	Connor	Paige	Jonas	Clare	Rohan	Karthik	Katy
Mentors:	**Mr. Prettyman**	**Dave**	**Tobi**	**Mr. Szeto**					

Agenda
Discuss Previous Meeting

Tasks:		
Programming	**LLMS**	**MMS**
Continue working on improving A* Algorithm	Test Linear Actuator on 20:1 motor See what can be done about the Carabiner	Test MMS Prototype with motor or servo

Mechanical Accomplishments:

Batter Bot

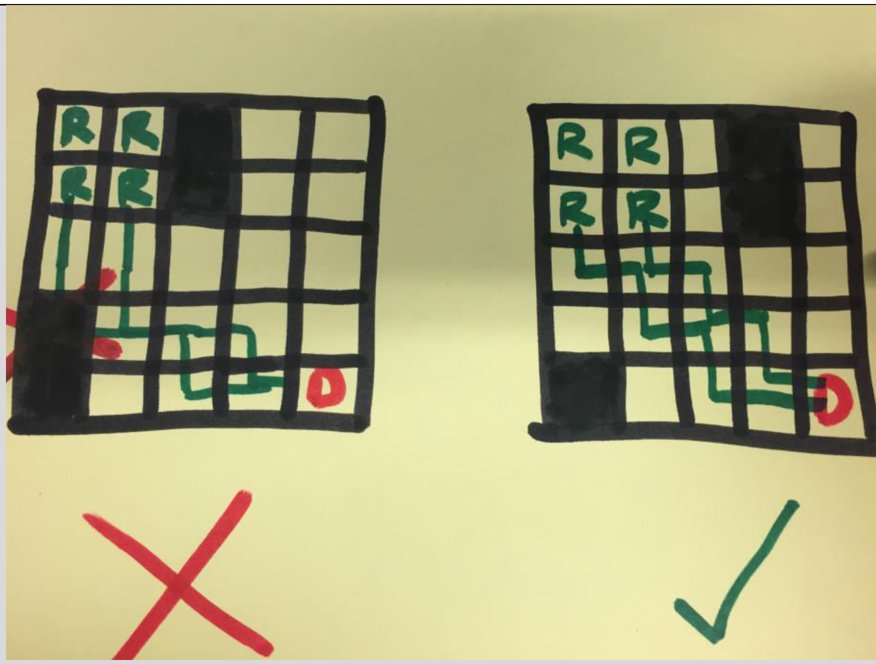
Tweak: Fix batter bot	 The Batter bot was broken because the bat came off. I fixed the batter bot by screwing the bat back on.

LLMS	
Fabricate a Solution: Carabiner	Finished up bolting the Carabiner so that it isn't held up together by a clamp. No changes to the design, everything was just bolted together

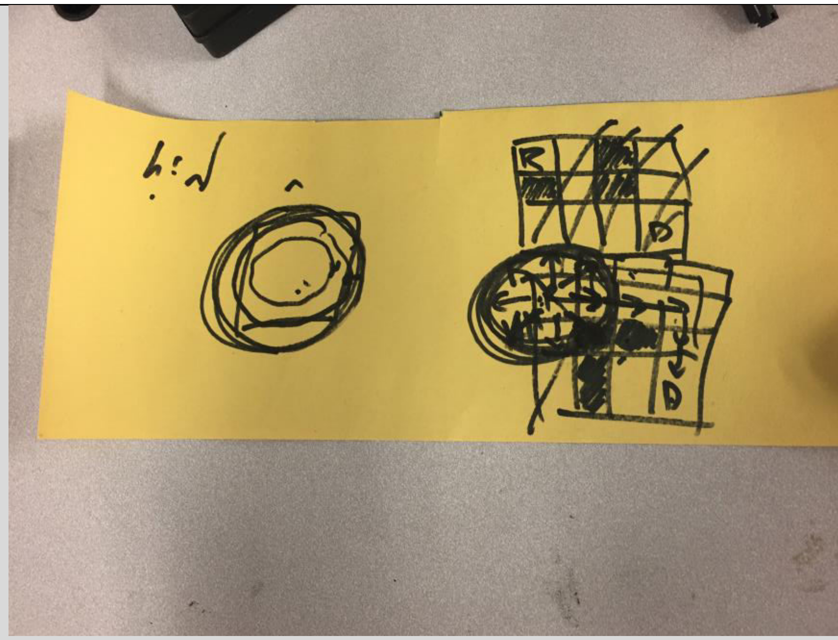
MMS	
Construct and Test a Prototype: Mounting a Servo	When using a Vex 393, we get a faster rotation, but get to have an extra motor. The Vex 393, though, uses a square axel and we did not want to work with gearing the Vex 393 to the harvester axel so we decided to mount a motor
Construct and Test: Mounting a	We drilled holes into a rev extrusion to fit a motor mount but did not have enough time to test the motor on the harvester

Programming Accomplishments:

Autonomous	
Construct and Test a Prototype: Finding legal path	While testing the A* algorithm, we had previously discovered that the robot was sometimes unable to find a legal path while accounting for the mass of the robot through the robot radius variable. We demonstrated this error with the diagram below. In the situation on the left, the robot was unable to compute a path that did not hit a barrier point, so an error would arise. On the right, the robot was able to compute a legal path, so no errors would show up.

	 We decided that we needed to make the program more flexible so it would not immediately crash when unable to calculate a path using the A* algorithm. We now need to go back and generate more concepts for changing the A* algorithms

Generating Concepts: Changing A* Algorithm	Jonas, Clare, Karthik, and Rohan brainstormed ways of editing the code to solve the problem with the A* algorithm, as mentioned above. We decided that if the robot was unable to calculate a route that did not encounter into barriers, the program would follow the following series of steps:
	
	• Create a new variable, called tempRobotRadius. This variable would first be set to the value of the initial robot radius, but could later be modified if the A* algorithm was unable to find a path that did not encounter any barriers.
	• Calculate all of the points within the robot radius, and set them as an array.
	• Check if any of the points in the array are touching a barrier.
	    ○ If none of the points are touching a barrier, the algorithm can move on to calculating the next step of the robot route.
	    ○ If one or more points are touching a barrier, then set the variable tempRobotRadius to be smaller.
	• Repeat this loop until the robot finds a route that does not touch any barriers.

	
Construct and Test a Prototype : Debugging A* Algorithm	We implemented the improved A* algorithm code but ran into several errors, which we needed to debug. 

Non-Technical/Discussion:

The carpet is removed from the lab.

Date: 11/10/18

Duration: 9:00 AM – 2:30 PM

Saturday, November 10, 2018 Meeting

Students:	Connor	Ian	Bryan	Patrick	Clare	Paige	Jonas	Katy	Karthik	Rohan
Mentors:	**Mr. Prettyman**				**Tobi**					

Agenda
Discuss previous meeting

Tasks:			
Programming	**Second Chassis**	**MMS**	**LLMS**
Start sampling & start programming an autonomous path.	Create a second chassis, so we can use a chassis that's similar to our competition robot for testing our programs	Try testing the Mineral Management System with a Servo	Make Linear Actuator longer Mount Carabiner to it

Mechanical Accomplishments:

Second Chassis	
Problem: Programming Chassis	The Programming Chassis is very different from the chassis we will use in competitions. This means that that we cannot accurately represent the actions of the robot when testing programs, which can cause discrepancies when transferring the code onto the competition bot.
Generate Concepts: 2nd Chassis	Build a second Chassis identical to the first one for use in programming. This will ensure that any programming will be accurate. Pros: • Will be more accurate because it is the same as competition robot • Programmers can program while builders are building
Document: Parts List	Connor made a bill of materials in excel so we know how many parts we need to build a copy of the chassis. He and Ian looked for the parts. However, we were missing some parts:

- 1 420mm REV extrusion
- 1 Mecanum wheel
- 3 motors

	A	B	C	D	E	F
1		Part	Amount	2nd chassis parts	percent	
2	Chassis	420 mm REV extrusion	6	5	0.833333	1
3		REV Plastic Lap corner bracket	8	8	1	0
4		Left Mecanum Wheel	2	1	0.5	1
5		Right Mecanum Wheel	2	2	1	0
6		Polycarb Plate	1	0	0	1
7		Neverest motor with gearbos	4	1	0.25	3
8		Electronics	3	3	1	0
9		Total	26	20	0.769231	
10	TMMS	6 in REV extrusion	2			
11		REV servo	1			
12		servo horn	1			
13		REV servo mount	1			
14		REV inside corner bracket	1			
15		REV 90° angle bracket	1			
16		MOE Team Marker	1			
17		Total	8			
18	Total	Total	34			
19						
20						

This Bill of Materials shows the amount of parts needed in column C, the amount we have available in column D, the percent we have in column E, and the amount missing in column F.

Generate Concepts: Cut REV extrusions

We have some very large REV extrusions. We could cut one of those to make the 420mm extrusion that we are missing.

Pros:

- Doesn't cost money

Cons:

- Might not be exactly the right size
- This method cannot be used to obtain needed mecanum wheels and motors

Generate Concepts: Order more parts

We could use the internet to order the needed parts.

Pros:

- Can be used to obtain all needed parts
- REV sells extrusions of exactly 420mm so we don't need to cut any

Cons:

- Costs money
- We need to wait for the parts to arrive

Generate Concepts: Find missing parts in the lab

While looking around the lab more, Ian found another 420mm REV beam. Instead of buying or cutting a REV extrusion, we could just use this one. Also, Mr. Prettyman found a box with several mecum wheels that we could use.

Pros:

- We don't have to pay for it
- We don't have to cut the REV extrusions
- We can immediately use it

Cons:

- We still need the motors

Fabricate Solution: 2nd Chassis

Despite not having all the necessary motors, Ian and Paige begin building the second chassis. The only pieces which we need to order are 3 Neverest motors with gear boxes. They build the REV framework for the Chassis and make sure it is the same as

	the original. Then, Paige, Katy, and Ian worked on getting the screws out of older mecanum wheels to use to screw in the metal plates on the new mecanum wheels. They also worked on threading the screw into the new mecanum wheels and also screwing on the metal plates.

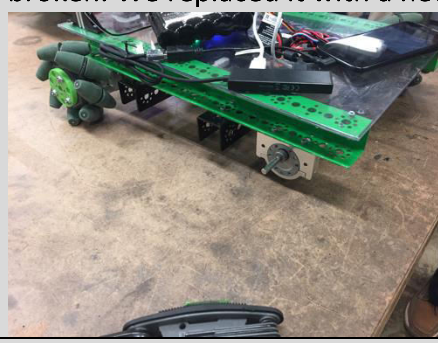
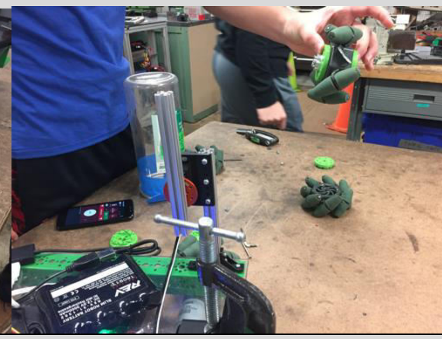
MMS	
Construct and Test a Prototype: Testing MMS	We drilled another whole at through the Rev extrusion that motor mount is on so that it would be more stable. After attaching a large sprocket to the motor, we saw that the sprocket was too far out on the axel to be aligned with the other sprocket on the harvester, so we used a scrap rev extrusion and a plate to mount the extrusions together Now the motor is further back, and the sprockets can be aligned We chained the sprockets together and used a motor tester to see it's harvesting abilities. It works very well! Next, we used the Rev Extrusion that the motor mount is already on the add a servo to flip the harvester into our robot We used a Rev Servo and drilled two holes into the servo horn so we could attach it to the Rev Extrusion We also wanted the Servo horn to be flat so we went to the Belt Sander and sanded it down We used the SRS Programmer from Rev to program the servo to be a 270 servo for an increased range of motion After testing the servo, we realized that it was flipping the wrong way so we needed to unmount the servo, reprogram the 270 degree limit, and then mount it back on This is the finished product:

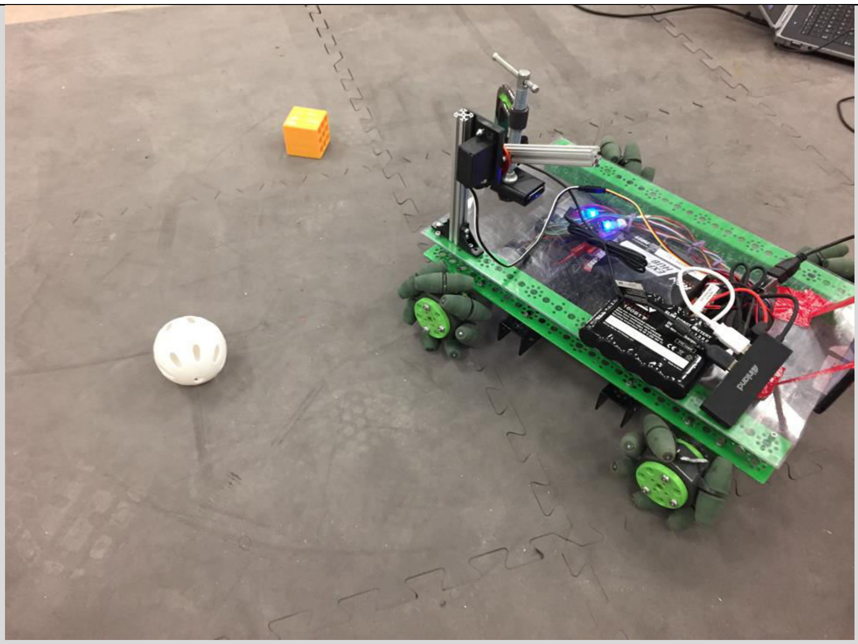
LLMS

Tweak: Linear Actuator	We purchased a 16-inch Actobotics C Channel and X-Rail so our Linear Actuator had enough range to reach the Lander bracket. We used another Linear Actuator kit to replicate our old one, but swapped out the C Channel and X-Rail for a longer one. This is meant to be cut down later, once we figure out how much we need to cut off in order to fit the height requirements.
Fabricate the Solution: LLMS	We combined the Carabiner with the Linear Actuator to create a working lift and used a motor tester to see if it works Spoiler alert: It works! And really well, too!

Programming Accomplishments:

Autonomous	
Construct and Test a Prototype: Repair Chassis	The first thing Rohan, Jonas, and Clare had to do was set up barriers in parts of the field because the lander and craters had been taken to a meet.

	 Then, when trying to strafe, we noticed that one of the wheels on our chassis was broken. We replaced it with a new one.  
Develop a Solution: Planning Autonomous	Jonas, Clare, and Karthik discussed how a sample autonomous path would run. The robot would start on the depot side and the path we came up with was as follows: 1. Use DogeCV to search for the gold mineral. The camera is initially pointed at the left and center mineral, so if it is unable to see the gold mineral (i.e. the gold mineral is on the rightmost position), the robot will rotate right until it sees the gold mineral. 2. The robot uses DogeCV's built in coordinate system to turn until the gold mineral is centered and the robot is lined up. 3. The robot moves straight forward, knocking the gold mineral off of its starting spot. 4. The robot moves straight back, and then turns until it can locate a Vumark. It uses the Vumark to localize. 5. Using localization data, the robot uses the A* algorithm to plot a course to the depot. There, the robot drops off the team marker. 6. The robot then backs up and parks along the edge of the crater.
Construct and Test a Prototype: Mineral Sampling	Clare and Jonas worked to use DogeCV in order to complete mineral sampling, which was successful.

	 They then worked on finding the VuMark to localize.

Date: Tuesday, November 13

Duration: 6:00-8:30 PM

Tuesday, November 13, 2018 Meeting

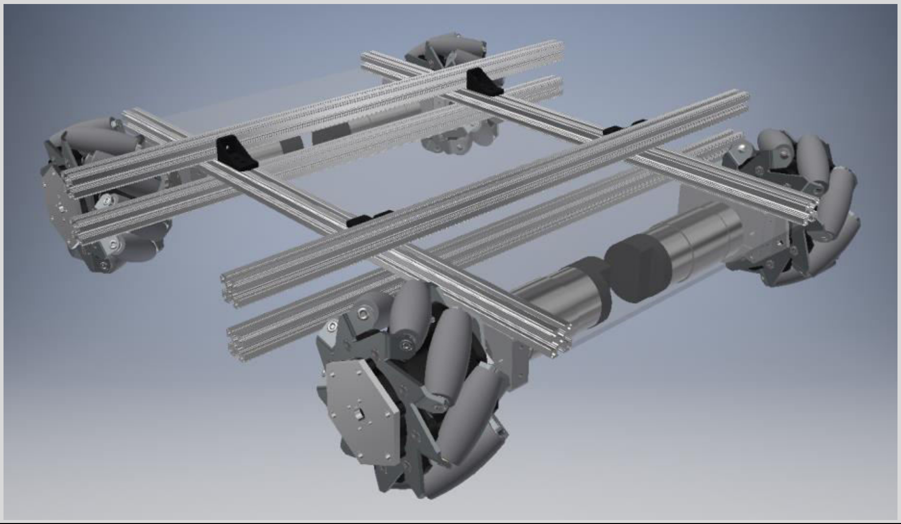
Students:	Connor	Ian	Rohan	Clare	Karthik	Bryan	Patrick	Katy
Mentors:	**Mr. Prettyman**	**Mr. Price**	**Tobi**	**Dave**				

Agenda
Discuss previous meeting

Tasks:		
Second Chassis	**MMS**	**Programming**
Continue working on second chassis. Connor Ian	Mount second servo and discuss lift	Use the TensorFlow neural network in the new ftc app & replace OpenCV to improve accuracy on the Mineral Sampling mission. Create custom neural network using TensorFlow (independent of FTC App) Compare the sampling options

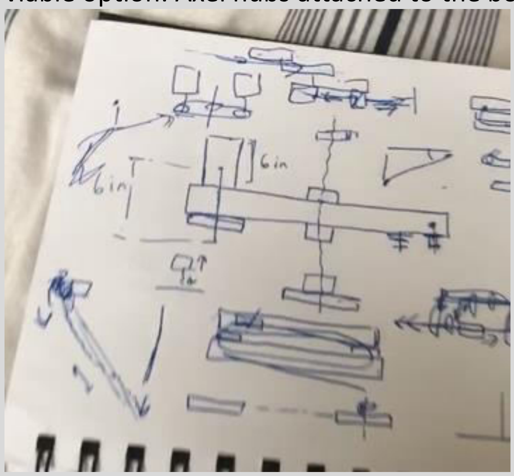
Mechanical Accomplishments:

Second Chassis	
Develop solution: Lack of motors	In our chassis design, we us REV motors with a 20:1 gear box. We don't have enough REV motors with 20 gear boxes and we are unable to order them online. This is an issue because these types of motors are on the actual chassis. This means we cannot create the second chassis with the materials we have right now and we have to regenerate concepts.
Generate Concepts: Neverest 40 Motors	The Neverest 40 Motors without gearboxes are similar to the motors with 20 gearboxes, so we decided we can use them on the second chassis until we can

	access the gearbox motors.
Develop solution: CAD with Neverest motors	Connor created CAD for a chassis that uses the Neverest 40 motors. The CAD is almost the same as the original CAD for the chassis. 
Fabricate Solution: 2nd Chassis	Ian continues building the 2nd Chassis. • Ian started by screwing on the metal plate for the 4th mecanum wheel for the second chassis. He the screws for the plate in a bag of screw that came with the new mecanum wheels. • Next, He finished aligning the rev extrusion beams of the chassis correctly by using the distance measurement from CAD and using the first chassis to align the rev extrusion beams. • After that, Ian and Mr. Price was preparing to drill a hole at the 4 intersections of the rev extrusion beams. They started by marking a point with a sharpy for the place that need to be drilled out. After that, I used a punch to make a hole in the metal were the dots that they marked. This will help when drilling out the hole • Next time, Ian need to drill out those holes and then continue building the second chassis.

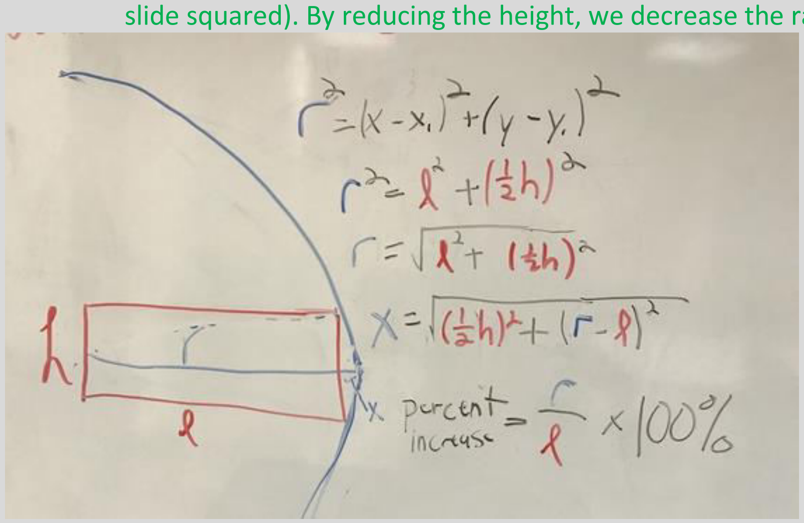
MMS	
Generating Concepts: Lifting the Minerals	We want to be able to score the mineral in the lander so we discussed various ways to lift the robot At home, Bryan and Patrick designed a linear slide on a motor that can rotate and extend This is advantageous because rotation and extension can happen simultaneously for faster scoring The robot will essentially be a giant 6 Degree of Freedom arm

They also discussed how the methods of mounting the slide on the robot to see if it is a viable option: Axel hubs attached to the bottom stage is the best approach

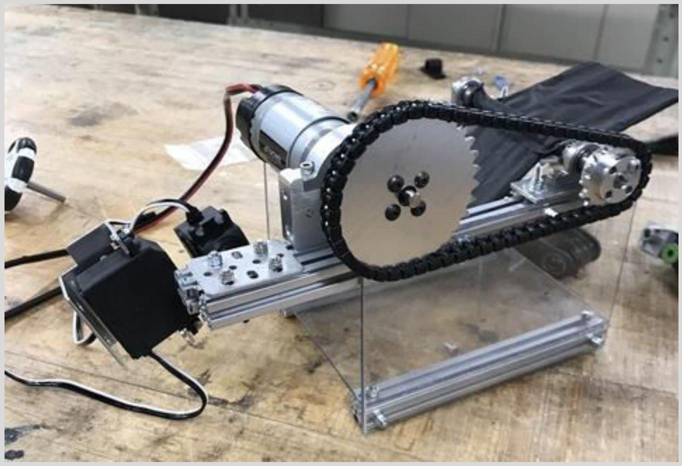
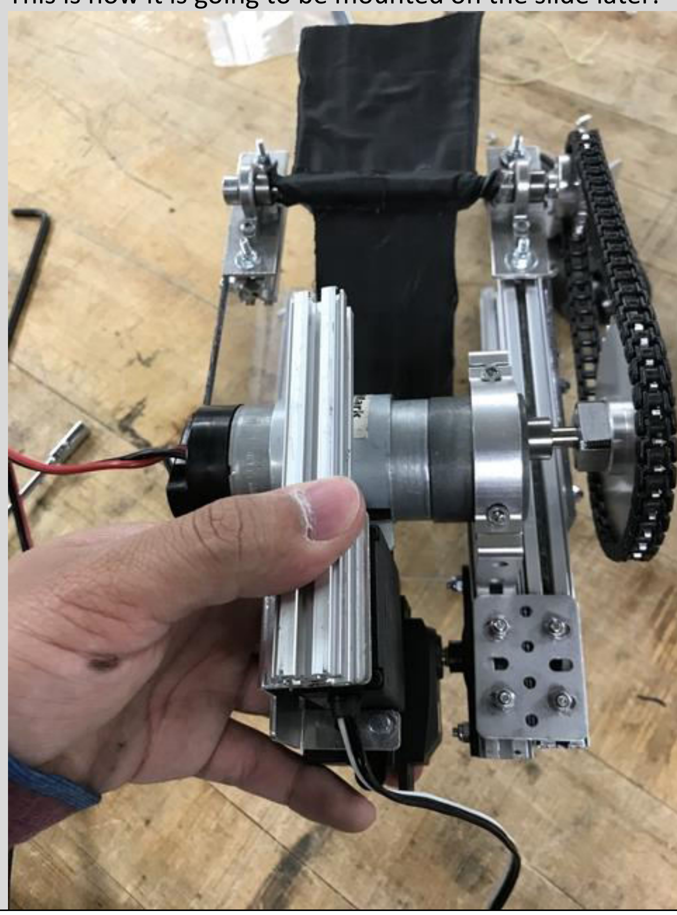


At the meeting, Rohan proposed that we used drawer slides because they are already built They also come with many other pros:

- They are easy to build like mentioned before
- They are thinner than stacking Rev, 80/20, etc
    - This means we can have it be longer because we do not lose rotation from an unnecessary radius increase from the height of the slide (the radius would be the square root ½ of the height squared plus the length of the slide squared). By reducing the height, we decrease the radial increase

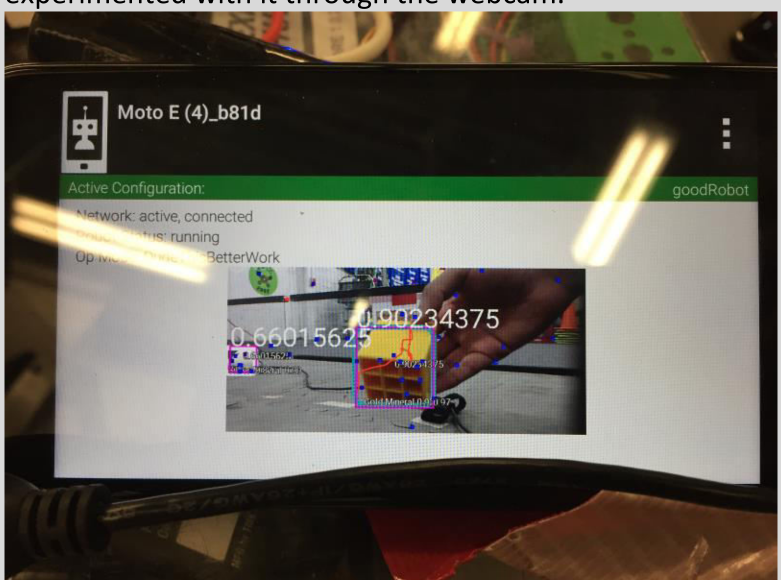
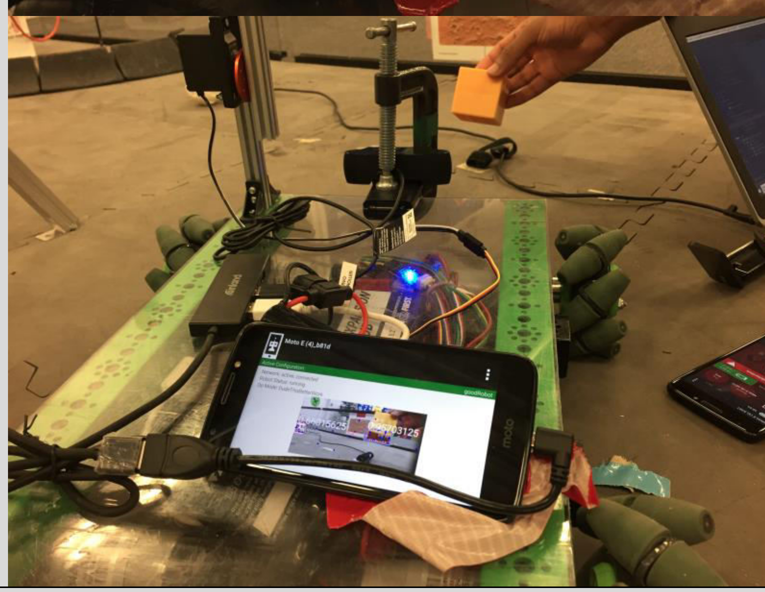


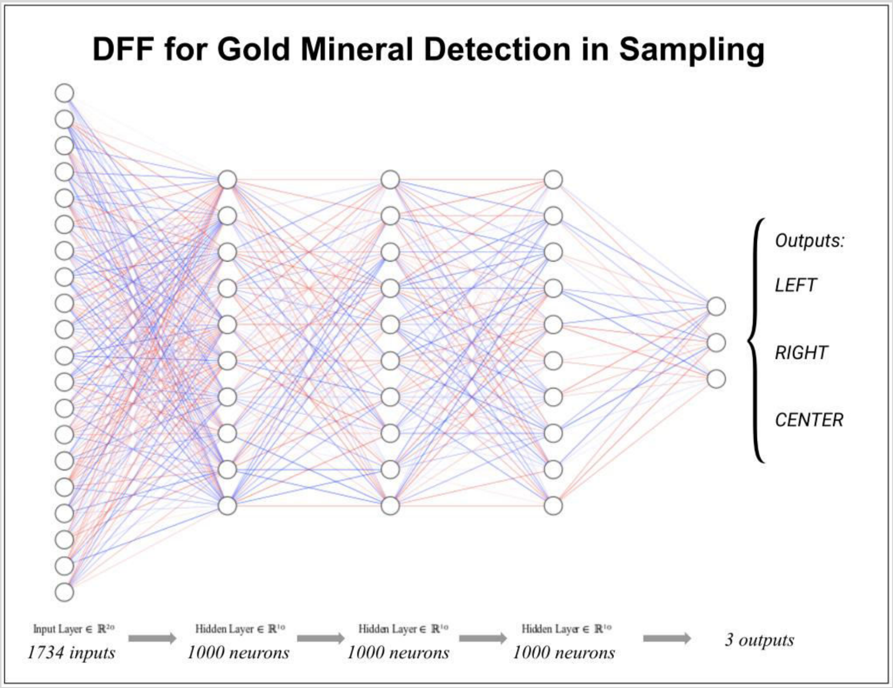
- The have bearings so they are smooth

	After discussing for a few minutes about the lift, we decided to come back to it later and work on the harvester We used another Rev Servo and Sanded Down Servo Horn like in the previous meeting but used 3M double sided tape to secure the Servo onto the other servo This adds a degree of freedom and also makes harvesting a lot easier  This is how it is going to be mounted on the slide later: 

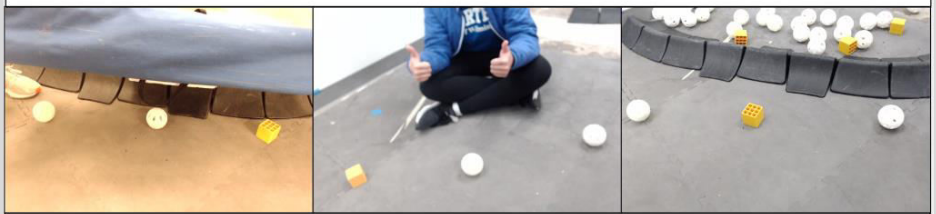
Programming Accomplishments:

Autonomous	
Evaluate: Mineral Sampling with	The programming team decided that while DogeCV was a quick and easy solution to the Mineral Sampling mission, it was difficult to identify the relative

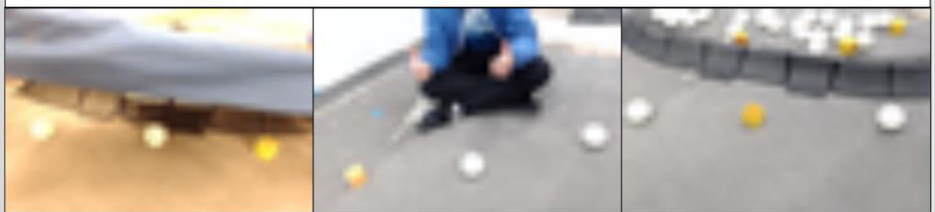
DogeCV	location of the Gold mineral, which resulted in errors in positioning. We decided that out autonomous programs would be more accurate if we found a more efficient way to analyze images and locate the gold mineral.
Generating Concepts: Neural Network	Rohan, Karthik, and Clare discussed ways of using a neural network to complete the Mineral Sampling mission. Using the many pictures Rohan took last meeting, we planned to implement TensorFlow, a software library that would allow us to experiment with machine learning. This would allow us to create a neural network.
Develop a Solution: Tensor Flow	In order to implement TensorFlow, we needed to download the latest version of the FTC Robot Controller from GitHub. This download included TensorFlow and would allow us to get started. This download took most of the meeting, so we decided to work on something else for the most of the time. When the download was complete, we implemented Tensor Flow and experimented with it through the webcam.  
Develop a Solution:	Before the integration of TensorFlow Lite into the official FTC App, we created a

Custom Neural Network	neural network with TensorFlow that could distinguish the left, center, or right position of the gold in the sampling minerals. **Choosing the Correct Structure** We decided to go with a ***deep feed-forward (DFF) neural network*** with ***backpropagation,*** a commonly used technique to train a neural network based around gradient descent.  There are 1734 inputs from the 1734 pixels in each of our input images, and 1000 neurons in each hidden layer. The final output has 3 possibilities. This neural network requires less training data because the problem at hand is fundamentally clear in terms of processing; there are no complex edge detections required. All the neural network has to do is distinguish between yellow and white and their locations in the images.
Construct and Test a Prototype: Our Neural Network	**Acquiring Training Data & Preprocessing (Total of 48 Images)**

Original Training Images – Taken With Webcam (720px * 480px)



Converted to Reduced Resolution Images (51px * 34px)



Converted to Array of Base-10 representations of hex #RRGGBB values (1734 Numbers) + Prediction

RIGHT	LEFT	CENTER
16777215,16580095,15725043,14540255,12698564,10790311,8948107,8027005,8878199,12167078,15525605,15855600,16448251,16646143,16777215,15658993,9868695,8750213,11974071,14672098,15922679,15593200,15066598,15658992,15724529,15724786,16119287,16119545,16185337,16251130,16448252,16382716,16645629,13881293,8816006,6975093,7698814,7633279,7435900,7633021,7435386,6975093,7501693,7896193,8488073,8159107,9211538,9671830,9802647,10131353,11775406,12764100,11119275,9671573,8816264,8158333,8158334,8289920,7961469,7958383,10654354,15133420,16777215,............,16777216	15461354,12368824,11842226,13947859,14474203,16777215,16777215,12497821,13413465,16315624,15527146,13552839,15856109,14013389,16382455,15395559,11246713,4794332,16710637,16777214,16777213,16645628,13486530,12697013,9736589,13158082,12434100,10657952,1123485,15197673,16579327,16777215,13355464,15592942,16777214,16645628,15263976,16514042,15264234,12303034,11710899,12040120,11579570,11250605,10592418,9210767,7697530,7697787,6842480,4737104,1973539,1020866,9670798,13355209,16777215,16184815,16053225,14737105,10789020,13355209,16777215............,.10920866	10196891,9933719,10065305,10262427,10065304,10065818,9673374,9410973,11381937,12234676,12827071,11642796,12892607,11773342,13352375,13089471,14669780,16579319,16777215,16579836,16579834,16776953,16776956,16711422,16184561,16447990,16711679,15592428,10390899,12493713,8201246,9380115,10423051,10629148,10099218,9637647,7538180,8144455,6578792,4538952,3223866,4474191,3684674,3158074,2960952,8487560,16052981,15987447,16052983,16316413,147998,10525599,10525856,10525856,10394012,9933718,10129553,11498350,12801607,12880774,12367805,13812938,............,13813938

Key ideas in images for the neural network:

- Changed background of images to show background does not matter
- Changed lighting of images to show lighting does not matter
- Changed tilt of images to show tilt does not matter
- Did not change order of minerals to show **only** ordering of minerals matter

NOTE: The preprocessing was automated using Python scripts to save time. The PIL (Python Imaging Library) was used to parse individual pixels on the images. We also manually labelled each image as to whether the gold mineral was in the left, right, or center.

The reason the images' resolutions were reduced was due to the fact that training the network would require more time. Although training the network at full resolution would be fine, it would possibly take a few minutes, and this can get cumbersome when refining and tweaking the data. We felt predictions could be made just as well at reduced resolution.

The process of converting to a Base-10 representation of hex #RRGGBB values:

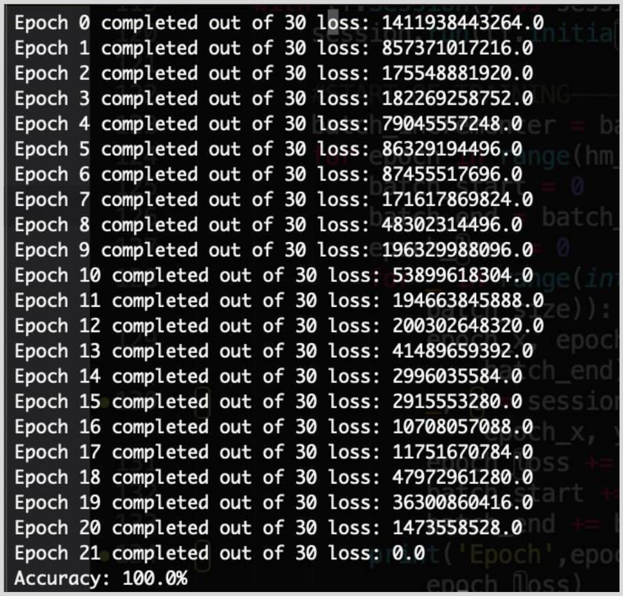
1. Take individual R, G, B (0 – 255) values of each pixel
2. Convert R, G, B values into one hexadecimal (base-16) number (#RRGGBB)
3. Take hexadecimal number #RRGGBB into a decimal (base-10) number

All the data was saved to a .txt file to be trained on later.

Training & Accuracy of Neural Network

Because we reduced the resolutions of the images in the preprocessing, training time for the 48 images was incredibly short: 5-15 seconds.

After training a successful model, here were our results.


```
Epoch 0 completed out of 30 loss: 1411938443264.0
Epoch 1 completed out of 30 loss: 857371017216.0
Epoch 2 completed out of 30 loss: 175548881920.0
Epoch 3 completed out of 30 loss: 182269258752.0
Epoch 4 completed out of 30 loss: 79045557248.0
Epoch 5 completed out of 30 loss: 86329194496.0
Epoch 6 completed out of 30 loss: 87455517696.0
Epoch 7 completed out of 30 loss: 171617869824.0
Epoch 8 completed out of 30 loss: 48302314496.0
Epoch 9 completed out of 30 loss: 196329988096.0
Epoch 10 completed out of 30 loss: 53899618304.0
Epoch 11 completed out of 30 loss: 194663845888.0
Epoch 12 completed out of 30 loss: 200302648320.0
Epoch 13 completed out of 30 loss: 41489659392.0
Epoch 14 completed out of 30 loss: 2996035584.0
Epoch 15 completed out of 30 loss: 2915553280.0
Epoch 16 completed out of 30 loss: 10708057088.0
Epoch 17 completed out of 30 loss: 11751670784.0
Epoch 18 completed out of 30 loss: 47972961280.0
Epoch 19 completed out of 30 loss: 36300860416.0
Epoch 20 completed out of 30 loss: 1473558528.0
Epoch 21 completed out of 30 loss: 0.0
Accuracy: 100.0%
```

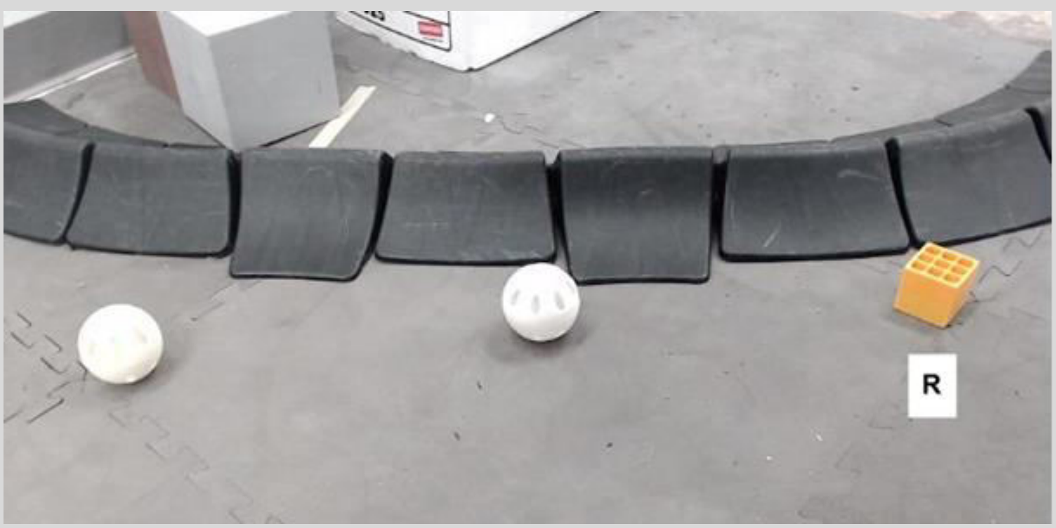
As shown on the image, the accuracy is 100% on our 48 images. The loss of 0.0 might be an indication of over-fitting the training data, but the network was able to successfully predict our test data, so the network indicates it has not overfitted to the point of inaccuracy. In other words, when we gave the network new data, it was able to successfully determine whether the gold mineral was in the left, right, or center.

Evaluate: Official TensorFlow Neural Network vs. Our Custom Neural Network

Our Artificial Neural Network

(See *Creating An Artificial Neural Network* in *Additional Summary Section)* for how we went about creating this.

We created a neural network with TensorFlow ourselves before we knew of the official TensorFlow Lite model.



Pros	Cons

• Could run on a separate webcam while Vuforia runs on another webcam • Can run independently of Vuforia unlike official TensorFlow Lite model • Runs in split seconds due to specialized implementation & code	• **Cannot easily give x position data** • **Cannot easily give angle to mineral**

The main downside was that this gave minimal data when compared to the official model. Despite its Pros, this major Con was enough to persuade us to go with the official model.

Official TensorFlow Lite Model

The official model was what we used in our final implementation.

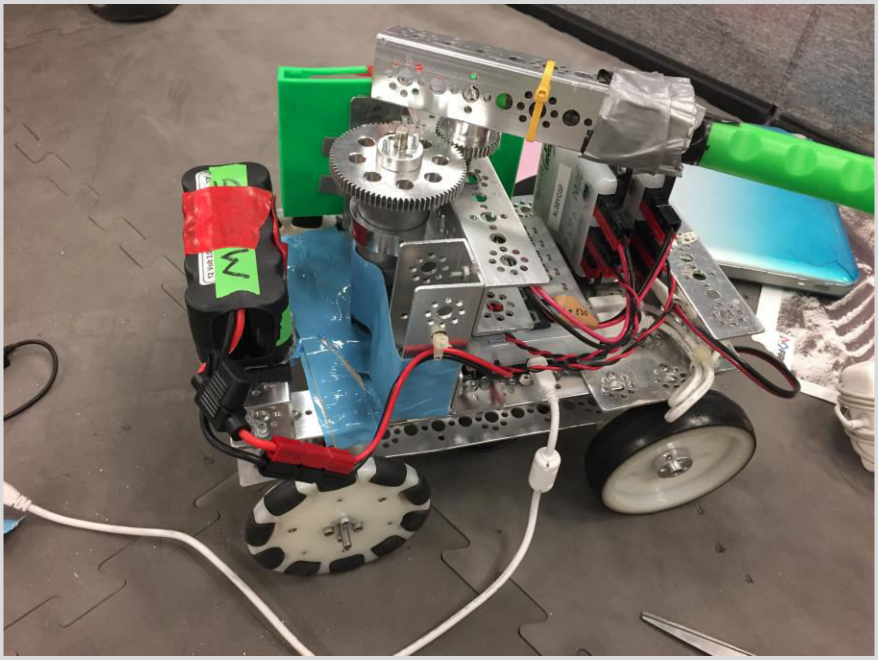
Pros	Cons
• **Gives X position data** • **Gives estimated angle to mineral**	• Cannot run without Vuforia ○ The official implementation takes camera frames from Vuforia • Can only run on one webcam with Vuforia

The amount of data & ease in which it could be accessed outweigh all the cons significantly in the official model, which is why we ended up using this in our actual implementation.

Batter Bot

Tweak: Batter Bot Drive

While we waited for the newest FTC Robot Controller App to download, Clare and Karthik worked on repairing part of the Batter Bot. Then, we brainstormed a new TeleOp program that would make the Batter Bot driving system easier and more accessible for all audiences at outreach events.



Previously, our Batter Bot TeleOp was this:

Input:	Controls:
Left stick	Forward/backward movement
Left/right bumper	Turning movement
Left/right trigger	Bat movement

We discussed changing it to:

Input:	Controls:
Left stick	Forward/backward movement
Right stick	Left/right movement
Left/right trigger	Bat movement

Non-Technical/Discussion:

The carpet is back in the lab.

Date: Saturday, November 17, 2018

Duration: 9:00-2:30

Saturday, November 17, 2018 Meeting

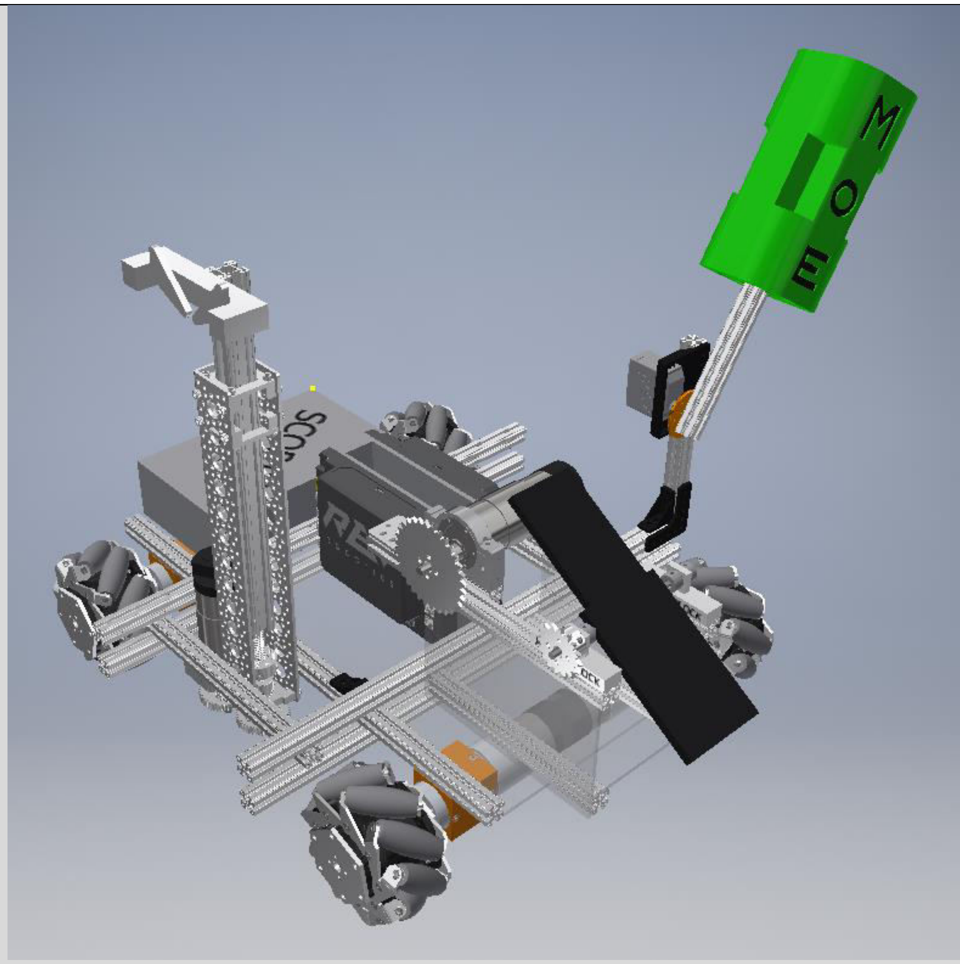
Students:	Connor	Bryan	Patrick	Clare	Jonas	Ian	Karthik	Marcus	Rohan	Paige
Mentors:	**Mr. Prettyman**		**Andrew**			**Arnav**		**Zach**		

Agenda
Discuss requirements for Qualifiers
scuss Previous meeting

Tasks:		
LLMS	**Programming**	**Team Marker Mechanism**
Mount Linear actuator onto robot	Finish implementing Tensor Flow and make progress towards writing competition-ready autonomous programs.	Make a Team Marker Mechanism for the main Chassis Connor Ian Marcus Byran

Mechanical Accomplishments:

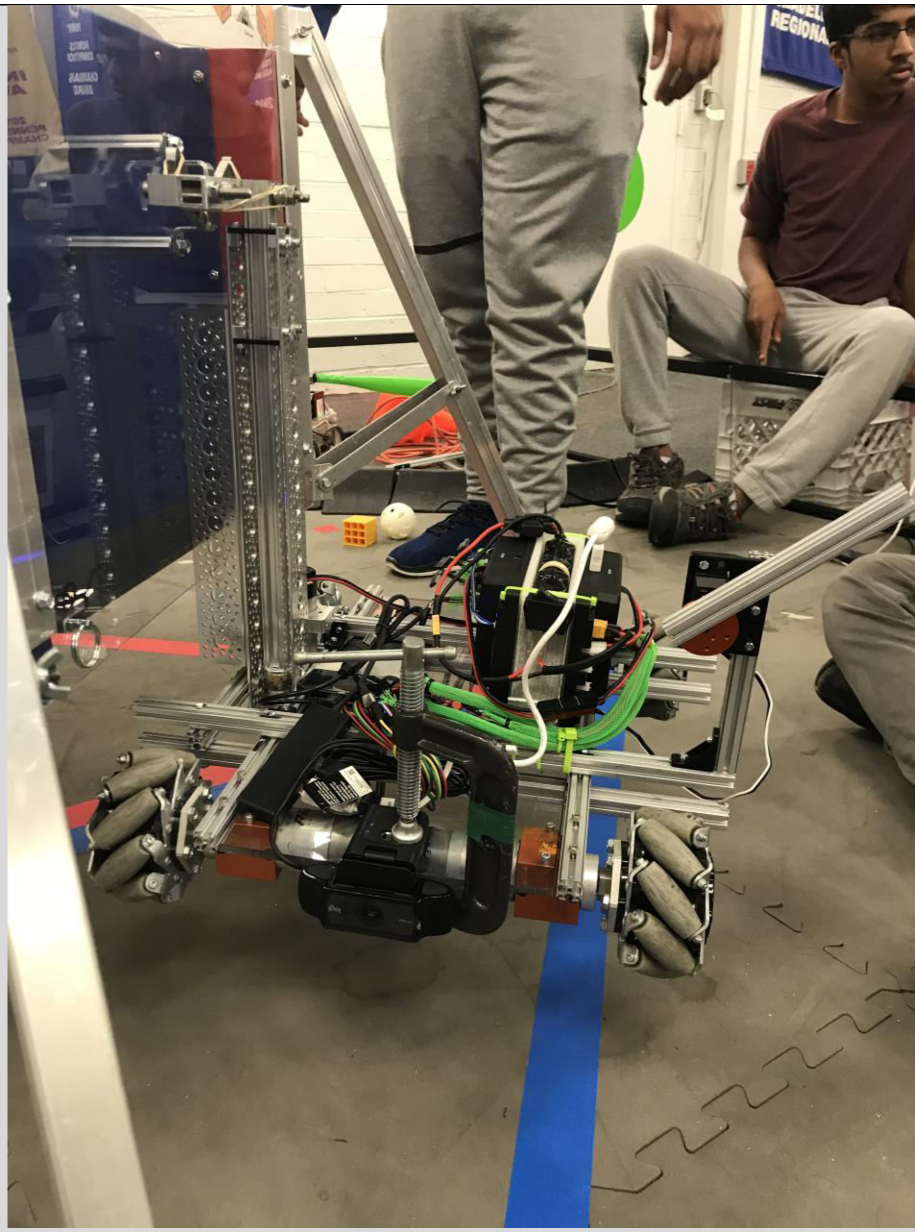
Chassis	
Develop a Solution: Adjusted CAD	Moved some things around based on what the builders said. Specifically, moved the TMMS to the other side. Also inserted the team marker into CAD.



LLMS

Fabricate the Solution: Mounting LLMS	We mounted the LLMS by putting another piece of REV, parallel with the side REV extrusions and pinning a screw through the REV extrusions perpendicular to it. We bolted both sides of the C-Channel to the corresponding REV beams.

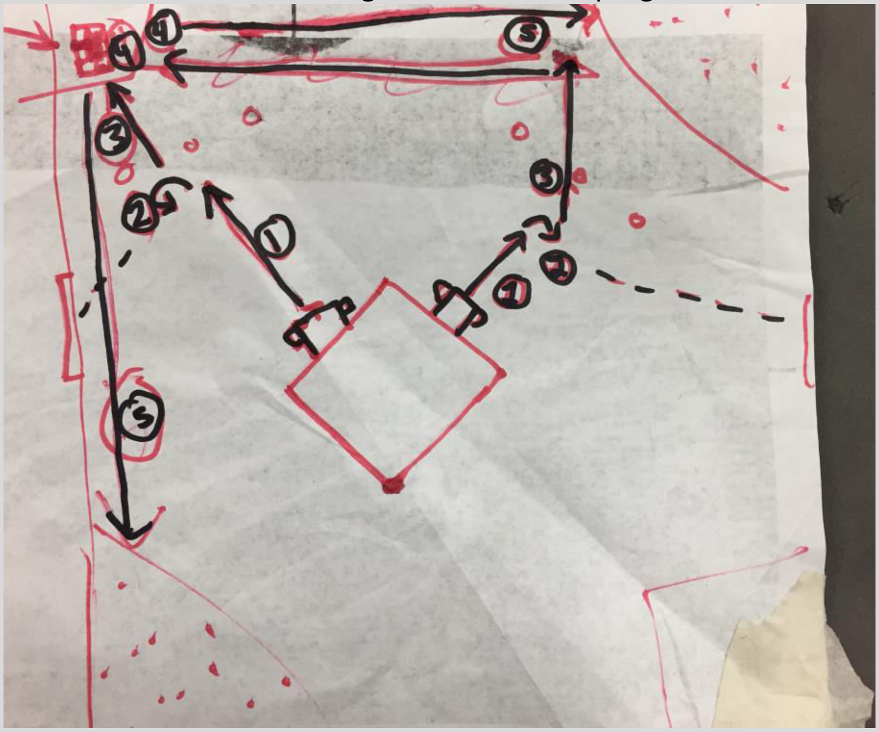
	 We used a motor tester to see if the motor would carry the weight of the robot.

	 We were able to successfully Land and Latch from the Bracket with our design.

Team Marker Mechanism	
Fabricate the Solution: Team Marker Mechanism for Main Chassis	• Because the first team marker Mechanism made was on the programming chassis, Mr. Prettyman told Ian to make a duplicate of the Team Marker Mechanism for the Main Chassis. • Marcus and Ian collected the parts for making the team marker mechanism. They collected the rev servo, servo mount, two rev L brackets, a servo horn, a servo horn screw and 9 hex screws and lock nuts. • For the two 6 in rev extrusion beams for the team marker Mechanism, Marcus and Ian took a 420 mm or 16.5 in rev extrusion and marked off two 6 in beams to cut out of the 16.5 in beam. Then, Marcus cut them out with the ban saw. • Then, Ian and Marcus started building the team marker mechanism. Ian started by making the team marker mechanism mount, which one of the 6 in rev extrusions Marcus cut and the two L brackets. • Ian attached the servo to the servo mount and then the servo horn to the servo

	with the servo horn screw. • Ian put screws on the servo mount to mount the servo mount to the 6 in rev extrusion of the team marker mechanism mount. • After that, he screwed the 6 in rev extrusion beam onto the center of the servo horn. This is where the servo horn screw is and when he needed to toughen the screws, he had to balance it on the screw. But he toughened one of the screws too much that he could not untoughened it or slide the extrusion off. • Then, Bryan helped I by taking the rev extrusion beam off and then putting the rev extrusion to the left of the center of the servo horn. • Finally, Ian mounted that completed Team Marker Mechanism on to the chassis with the help of Connor and Byran to put in the right place and direction.

Programming Accomplishments:

Autonomous	
Develop a Solution: Planning Autonomous	Jonas, Karthik, and Clare talked with Mr. Prettyman and Arnav about the ideal path the robot should take during an autonomous program.  Based on the general consensus among FTC teams, we decided that when positioned in front of the depot, we would: 1. Sample minerals 2. Move forward to the depot and drop off the team marker 3. Stay to the left and park in the other team's crater When positioned in front of the crater, we would: 1. Sample minerals 2. Move to the depot and drop off the team marker 3. Move straight backwards and park in our own crater We all agreed that these paths would minimize possible collisions without

sacrificing much time or efficiency.

Construct and Test a Prototype: Tensor Flow Autonomous

Jonas, Karthik, Rohan, and Clare worked on developing a logical series of steps to identify what position the gold mineral was in based on the image recognition used by Tensor Flow. Then, we worked on creating the final autonomous program for the blue depot.

The programming team discussed the various steps and divided the program into parts. As we progressed, we noted the results of each.

Step:	Result:	Description:
Turn until the robot can locate two minerals.	Successful	The robot is able to consistently identify the two leftmost minerals.
Use logic to determine the relative position of the gold mineral.	Successful	Judging from the two minerals the camera can see, the robot is able to identify where the gold mineral is.
Calculate the angle that the robot has to turn in order to face the gold mineral.	Successful	Using distance and the coordinates of the minerals relative to the camera, the robot consistently calculated the correct angle.
Drive into the gold mineral.	Successful	The robot is consistently able to hit the gold mineral.
Navigate to the team depot.	Successful	The robot is able to use the A* algorithm to move to the team depot, with little variations in positioning.
Drop off the team marker.	Successful	After some troubleshooting, the servo drops the team marker into the depot.

Non-Technical/Discussion:

- Discuss what we need for being ready for Qualifiers on December 1st
  - We are second on the waitlist for Hat Tricks Qualifiers in Pennsylvania, and if we are invited, we will accept
  - We need to know what we need to get done and discuss extra meetings that might be necessary

Non-Technical	Robot
Notebook	Linear Actuator
Packing	Team Marker Mechanism
Drive Practice	Camera
Business Plan	Electronics
	Panels + Flag Holder
	Not Priorities: Work on 2nd Chassis and Mineral Management System

(Extra) Meetings

M 11/19 1 PM –6 PM	T 11/20 1 – 8:30 PM	W	Th	F	S 11/24 Same meeting	S
M	T 11/27 Meet	W	Th	F	S 12/1 Qualifiers	S

We decided to have these extra meetings to make sure we are ready for a Qualifier on December 1st. We still need time for judging practice and drive practice, but we have a meet on the Tuesday right before the Qualifier. This means we lose that meeting, so we need to meet more this week, and maybe more the next week. We can get good driving experience at the meet, too, and work on the judging practice on another meeting. This should put us in a good position to compete for the Hat Tricks Qualifier

Engineering Notebook

We're starting to print notebook entries to see how they format and to see our choices for making footers and page numbers

After printing out our first entry, we saw that the margins are very big so we will now use .5-inch margins from now on

- Had change the margins and reformat the table for ALL previous meetings and the TEMPLATE

We also saw that yellow was very hard to see on the gray background. We looked that the color options in the Microsoft Word Online Standard Color Palette, and decided that gold was the best option

- Had to change ALL yellow text from previous meetings to gold instead of yellow

Started a complete notebook PDF (with all of the completed meetings) in Adobe Acrobat Pro for easy page manipulation

Date: 11/19/2018

Duration: 12 PM – 6 PM

Monday, November 19, 2018 (Extra) Meeting

Students:	Patrick	Bryan	Rohan	Karthik
Mentors:	**Arnav**			

Agenda
Go straight to lab

Tasks:	
Programming	**Team Marker Mechanism**
Program encoders for new programming chassis drivetrain Fix A* Pathfinding Algorithm Working on intelligent autonomous	Remount the Team Marker on the side

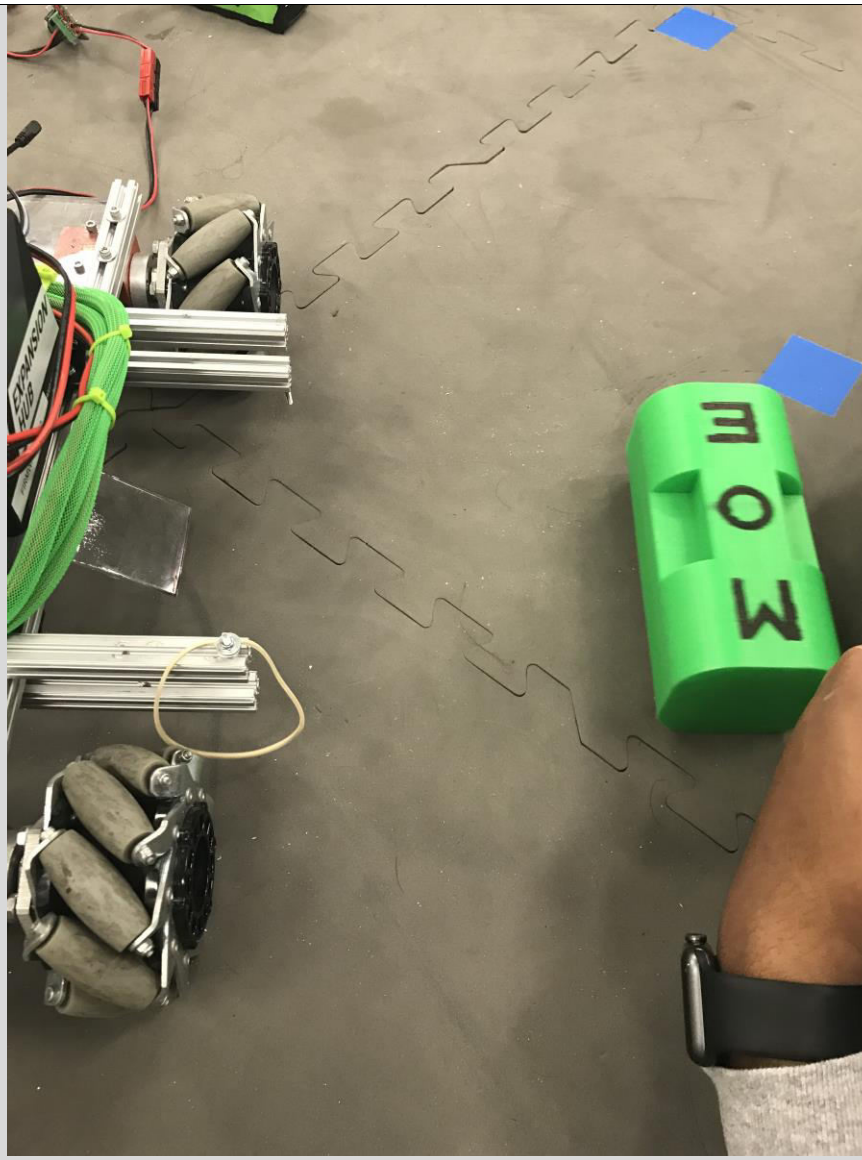
Mechanical Accomplishments:

LLMS	
Tweak: LLMS	LLMS Gear popped off after programming error lead the motor to keep running passed its limit. We tightened the screws and planned to put a limit switch later on.

Team Marker Mechanism	
Fabricate the Solution: TMM	From the autonomous testing last meeting, we saw that it was more convenient to drop the team marker from the side of the robot instead of the front We quickly remounted the team marker mechanism to the side for a more efficient autonomous, using a different method of a quick release with a rubber band

	The Team Marker is placed on a ramp and is held inside the robot by a rubber band. This provides support across the entire Team Marker while still being able to be released quickly. 

When dropped, the Team Marker seems to roll away, which shouldn't be a problem, because it will only roll towards the Depot, instead of away. We would still need to be inside the Depot to properly claim it, because rolling isn't allowed.

	 This shows the distance it rolled.

Programming Accomplishments:

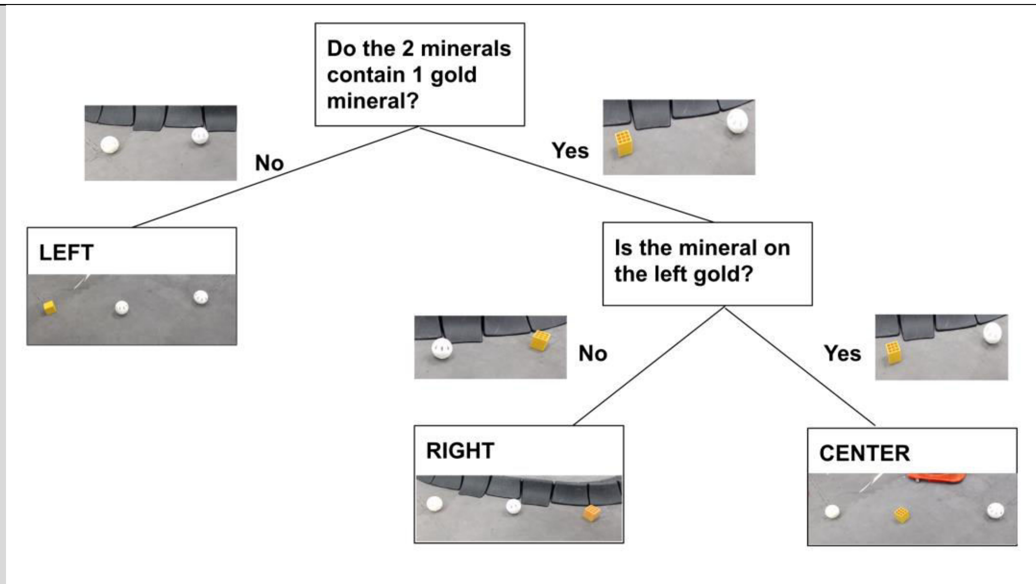
Autonomous	
Construct and Test a Prototype: Encoder Tics In 2 Directions	Since encoder tics are used throughout our robot's independent movement strategies, getting them right across vertical and horizontal movement is vital. Here, we decided to properly measure encoder tics in forward/backward movement and strafe movements. **FWD Testing Values** 51 -> 64 (only made 75% of the way) 64 -> 75 75 -> 71 71 -> 73 73 -> 72

<table>
<tr><td></td><td>72 was clearly the optimal choice.

STR Testing
85 -> 94
94 -> 100
100 -> 101
101 -> 102
(noticed a motor is not straight which slightly affects strafing – will fix tomorrow)

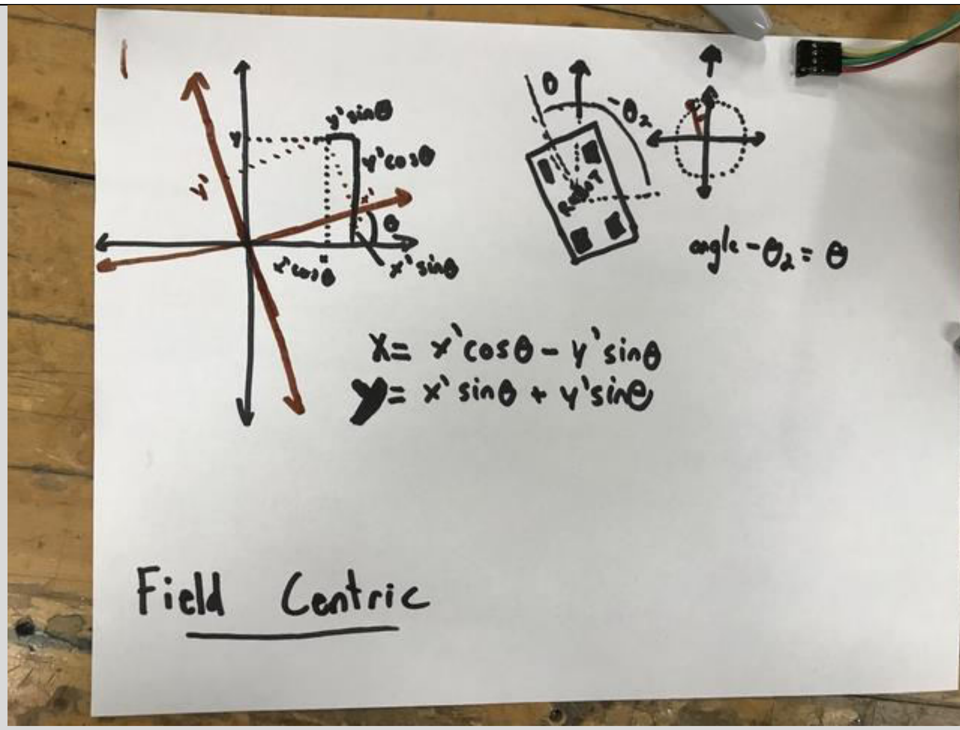
102 was clearly the optimal choice. Despite the fate that the motor was not straight, this did not negatively affect the strafing precision by anything notable.</td></tr>
<tr><td>Construct and Test a Prototype: Gold Mineral Decision Algorithm</td><td>After the addition of TensorFlow into our autonomous, we realized that when on the field, our robot’s camera could only see two minerals with the camera was in its current position & robot’s orientation. The robot could be moved in a few seconds to see all 3 minerals, but writing an algorithm to figure out where the gold mineral is would save precious seconds in autonomous for the robot in other places.

Since our robot was only able to see two minerals on the field, we had to write an algorithm to figure out which one is gold. To accomplish this, we guaranteed that the two minerals we saw would be the 2 right minerals out of the 3 in sampling. If the 2 were silver, the gold would be on the left. If the gold was the left of the 2 right minerals, it would be on the center. If the gold was on the right of the 2 right minerals, it would be on the right.</td></tr>
</table>



Evaluate: Gold Mineral Decision Algorithm	After testing the algorithm on all the possible cases multiple times, the algorithm had a 100% success rate. The algorithm would now save time in autonomous with the robot independently thinking rather than wasting time to realign and see all 3 minerals.

Tele Op	
Fabricate the solution: Driving and lift	We wanted to see if we were able to hang during autonomous so we programmed the triggers to control the LLMS up and down and used the mecanum code that the other programming chassis used
Tweak: Field-centric driving	While the driving was being tested, we also programmed a Toggleable Field Centric Drive This allows the robot to move relative to the direction that the driver is facing (Up will always be away from the driver no matter which way the robot is facing) This allows for the robot to be more intuitively driven



The joystick is essentially a coordinate plane with an x and a y axis. The values are usually directly put in as the forward power (y axis) and the strafing power (x axis) but now they are remapped onto a tilted coordinate plane. This tilt is based on the angle of the robot.
The new coordinates are what the position of the joystick would have been if it wasn't in field centric because it compensates for the turn of the robot.

We did this because: Implementation is fairly easy compared to the what we get out of doing it. Driving is a lot more efficient with holonomic drivetrains but it can get confusing when the robot can move in different directions. We did this tweak on our first attempt without errors, so it was well worth it.

Non-Technical/Discussion:

Reviewed Notebook requirements and self-reflection rubric

- We have a couple of smaller things we need (Cover page, table of contents, and summary page) but content seems high quality
    - May consider highlighting "Whys" because although we write it, it's not a super noticeable. Might use a different text color or a separate section for reflection.
        - **Idea: introducing a** ***WDTB:*** section meaning "We did this because" so that it is a prominent feature in each meeting or just not have the acronym for better readability ***We did this because:***

- Meeting summaries may increase readability and easier to skim through the meetings

Meeting Summary:

- Team Marker mechanism is now on side and works very well
- We can now hang in end game
- Field-centric drive was programmed
- We can drop during autonomous

Date: 10/20/18

Duration: 12 PM - 8:30 PM

Tuesday, November 20, 2018 Meeting

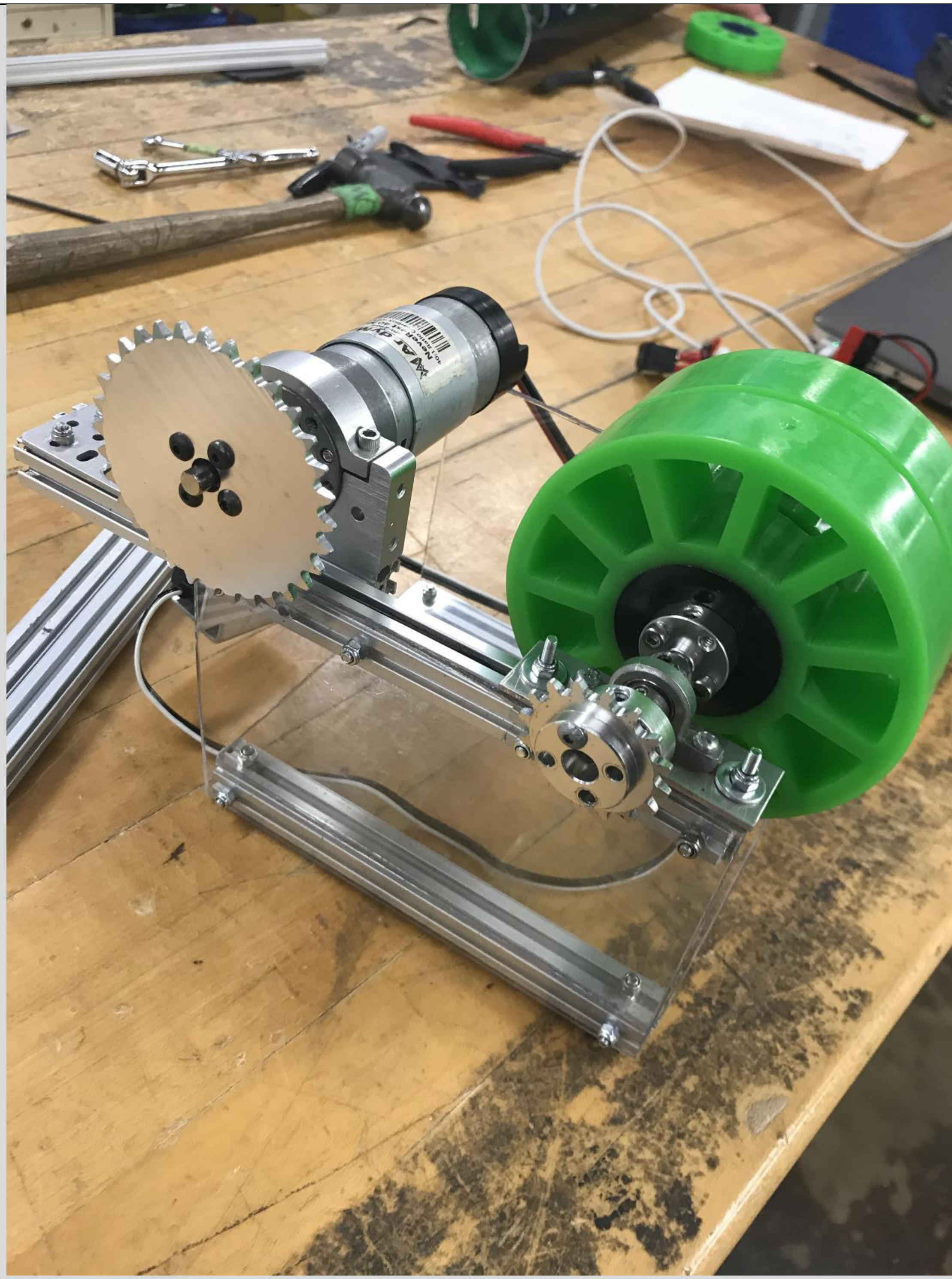
Students:	Patrick	Bryan	Rohan	Karthik	Connor	Ian	Paige	Clare
Mentors:	**Mr. Prettyman**	**Arnav**	**Andrew**	**Dave**	**Zach**			

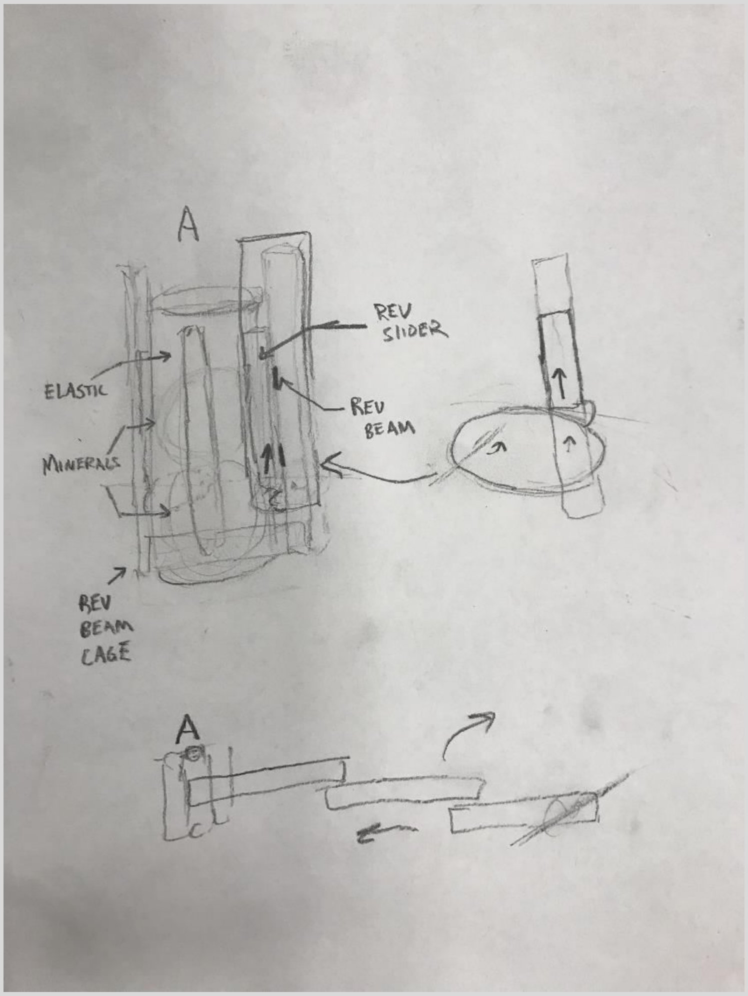
Agenda
Go straight to lab

Tasks:	
MMS	**Programming**
Get started with new designs and fabricate old designs	Continue programming the final autonomous. Refine TeleOp.

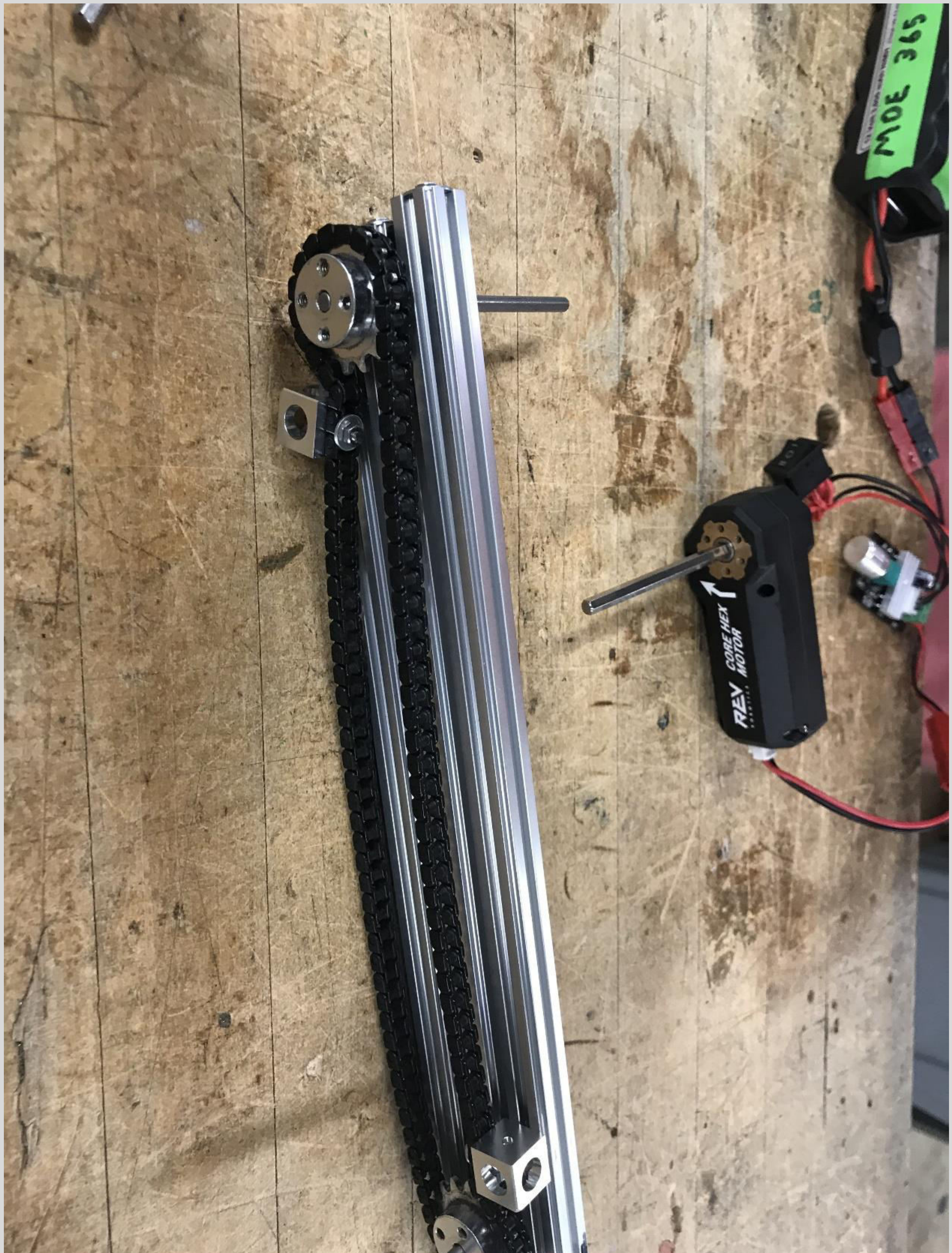
Mechanical Accomplishments:

MMS	
Evaluate: Harvester	We realized that if we harvest using the design we have right now, the flap sometimes get caught on the minerals if it already has two in the basin. When the flap gets caught, it strains the sprocket with the chain and the chain usually pops off. We wanted to change the design to remove this possibility, so we went decided to test Green Compliant wheels. We hoped that the squishiness of the wheels prevented the motor from straining and the ball would just get squished instead of stopping the motor from spinning. The axle holes for the wheels are too big for the axle, so each one got a motor mount. There was only enough space for 2 wheels

	
Evaluate: New Harvester	Using the green compliance wheels, a similar issue occurred. The wheels did not comply as much as we hoped, so the motor would strain when trying to harvest a mineral. Also, the wheel does not have enough reach, but also is too low so the design over all did not work. We have to go back and generate concepts.
Generate Concepts: Tennis Ball Collector	We revisited something that we made over the summer that could be used to collect only balls

	Pros: It's already built We don't need to worry about sorting Cons: Can't collect gold minerals Need a mechanism to actuate it Smaller margin of error than a traditional harvester We continued to brainstorm on the design, thinking of a way of lifting it vertically upwards with a rotating Cam and slamming it back downwards using elastics.  We sketched something quick as we have a competition soon. (Scoring very little is better than scoring nothing, we decided.)
Fabricate the solution: Tennis Ball Collector	We built the cage for the Tennis Ball Collector so it can ride it up and down.

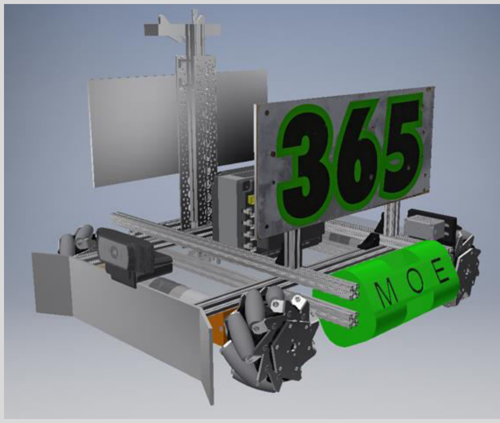
	
Evaluate: Tennis Ball Collector Cage	We saw that this design will probably be too bulky to use, and it would also be difficult to push it straight up, especially with elastics. This will create a lot of friction every time it goes up and down. (Not good)

Fabricate the Solution: Chain drive	We built the Chain Drive that we planned to use in most variations of our MMS 

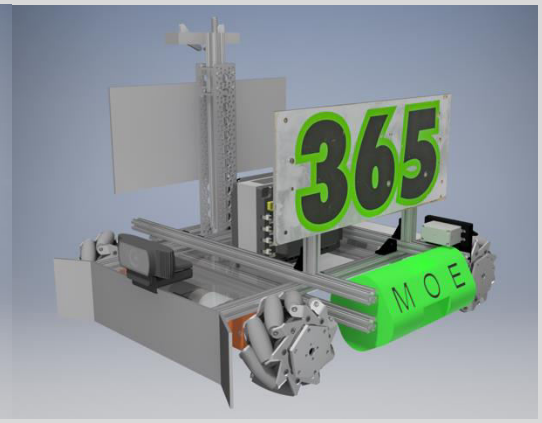
CAD

Fabricate the Solution: Finalize CAD	Connor finished the CAD for the robot today. This included adding side panels with the team number, updating the team marker mechanism to match the current

design, and adding the camera and pusher. He also began creating high-quality renders of the robot and its components for use during competitions. However, these can take 3-4 minutes to render so it's best not to do too many. Connor plans to have a slideshow of these CAD renders running on the laptop in the pits at the competition.



Normal CAD picture

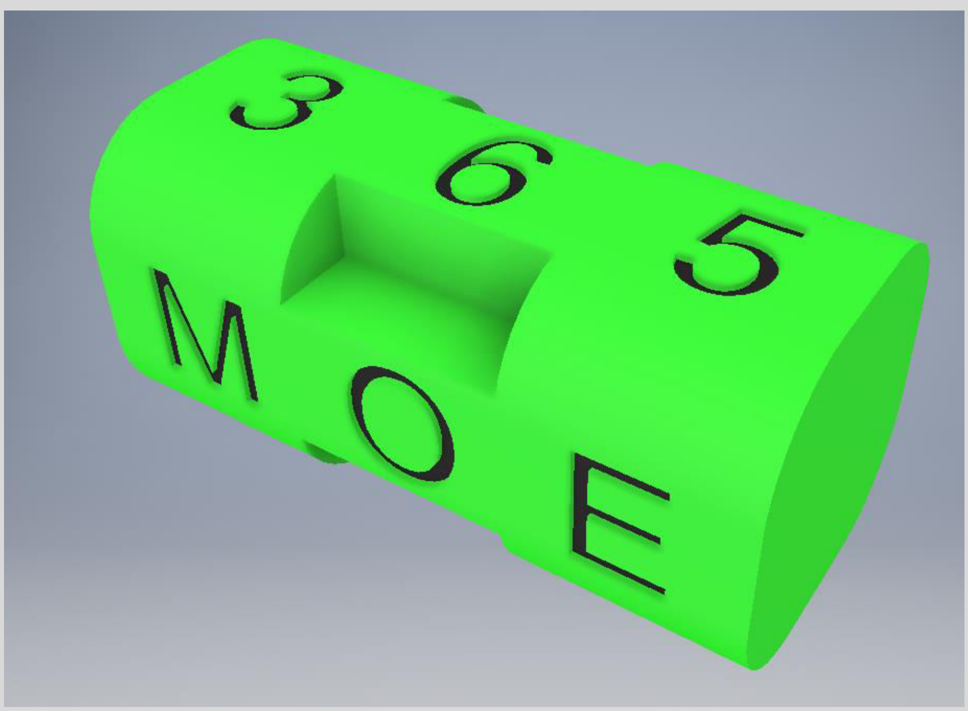


High-Quality Ray Tracing

Team Marker

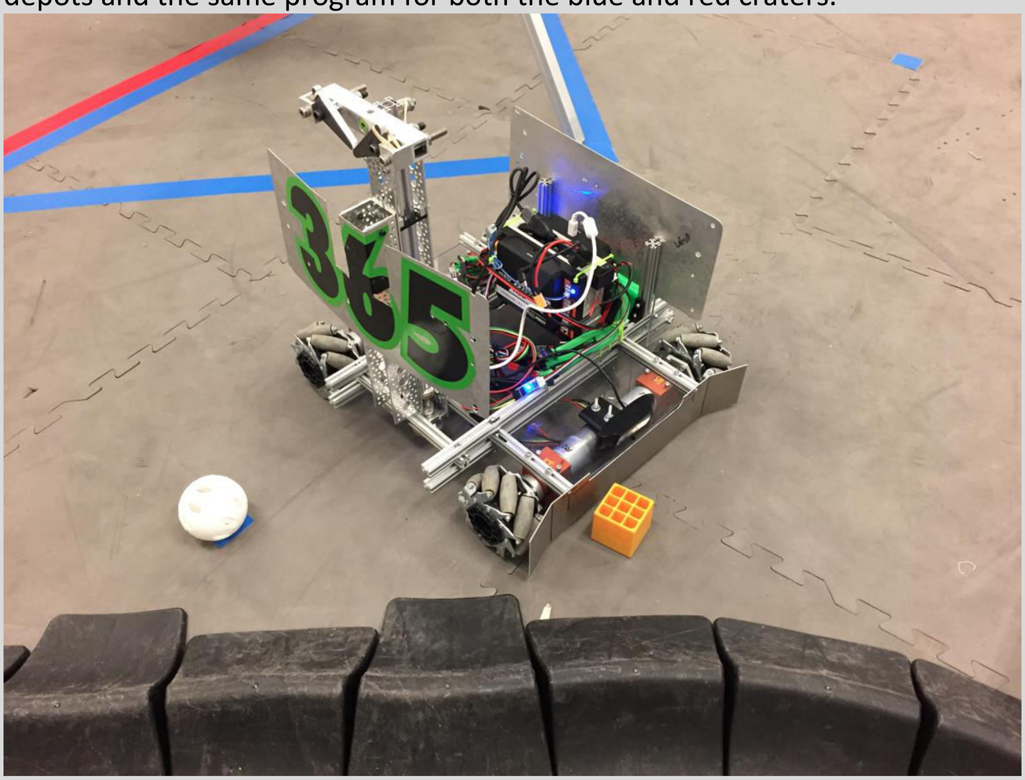
Tweak: Team Marker Design

The new Team Marker design has the team marker positioned horizontally, but the text is meant to be read vertically. Ian rotated the text in CAD to be horizontally oriented and took the holes out because they are not needed with the new team marker mechanism.



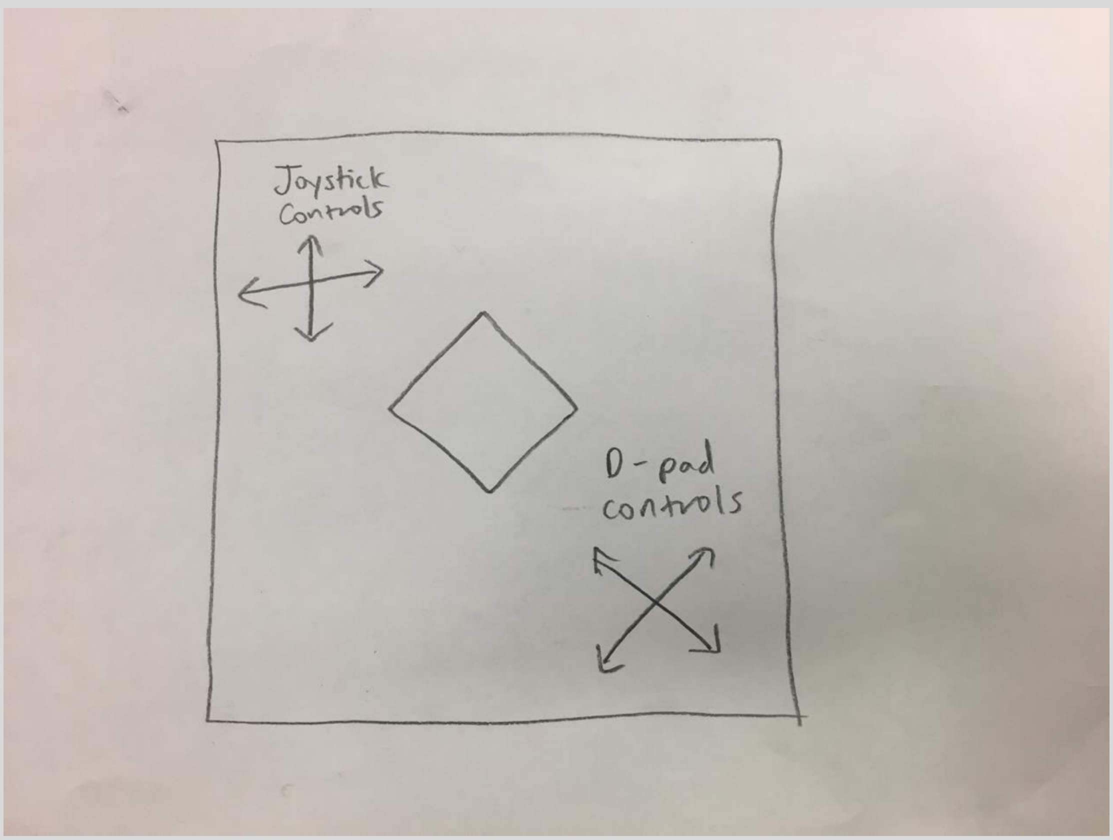
Ian sent the CAD to Connor and then started printing it on the 3D printer. It will not be done by the end of this meeting but it will be done by the start of next meeting.

Programming Accomplishments:

Autonomous	
Construct and Test a Prototype: Lifting Program	After upgrading to the new robot with the linear actuator installed, Rohan, Karthik, and Clare worked on writing a program to lower the robot in autonomous. However, we ran into one bug that we needed to fix. • We had initially decided that we only needed to use Tensor Flow at the beginning of the program. Therefore, after seeing the minerals, our program disabled Tensor Flow. • However, when updating this program, we decided that we wanted to make multiple checks to tell if we could see the minerals. We instructed the robot to use Tensor Flow to identify minerals. • Due to the fact that TensorFlow had already been disabled by this stage of the program, this created an error message since the robot was unable to use TensorFlow. After some debugging, we recognized the issue and corrected it. The robot can now unlatch from the lander and lower to the ground without incident.
Fabricate Solution: Mineral Sampling Autonomous	We then worked on programming mineral sampling on all sides of the lander. We decided that, for the next few competitions, we were going to use an autonomous program that had all turns and movements hard coded based off of the input from Tensor Flow. Due to this, we could use the same program for both the blue and red depots and the same program for both the blue and red craters.  DEPOT SIDE:

	After detecting the gold mineral, the robot would turn towards the gold. Then, it would push the mineral into the depot. Once in the depot, it would rotate a servo that releases the team marker. We have not yet programmed the robot to park in the crater. CRATER SIDE: After detecting the gold mineral, the robot would turn towards the gold. Then, it would push the mineral off of its starting location. In later versions, we would like to drop off the team marker, but we have not finished this yet. We have not yet programmed the robot to park in the crater.

Tele Op

Tweak: Diagonal Movement	We then worked on tweaking the Tele Op program. Initially, we had set the side the webcam was mounted to as the front of the robot. However, this created a problem because when trying to hang on the lander, we had to move diagonally in order to line up with the lander. To fix this issue, we programmed a second set of controls using the d-pad that would be Lander Centric and would move diagonally relative to the driver. This made is much easier to latch on to the Lander in the End Game.  We also programmed the left and right bumpers to be used for slow, more precise turning movements.

Non-Technical/Discussion:

Requirements for December 1st Qualifiers:

1. **Packing**
2. **Judging**
3. **Notebook printing**

Drive teams – may prefer 2 drive teams

BE able to present a judging presentation on Saturday

Decided to choose to not have a bullet pointed slide show for mechanical because we prefer judges to be looking at the robot instead of the slides.

Ian and Paige worked on starting to pack for the Delaware meet and Padua Academy on November 27 and the Pennsylvania State Qualifier in Hatboro on December 1.

Date: 11/24/18

Duration: 9 AM – 2:30 PM

Saturday, November 24, 2018 Meeting

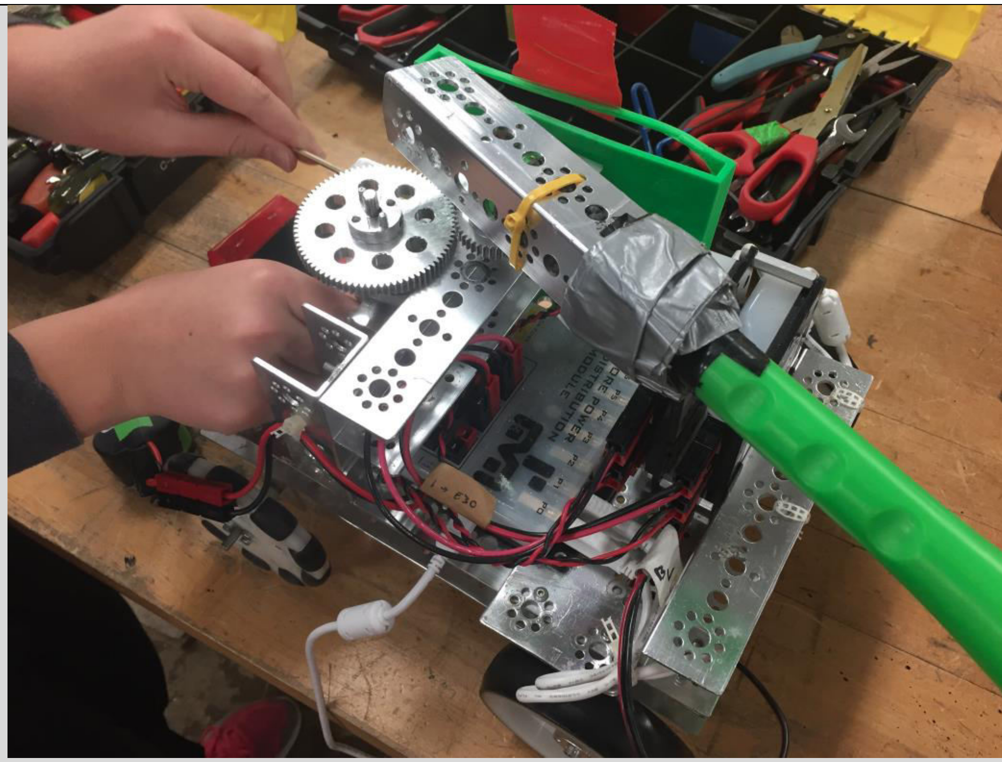
Students:	Rohan	Karthik	Clare	Paige	Jonas
Mentors:	**Mr. Prettyman**			**Arnav**	

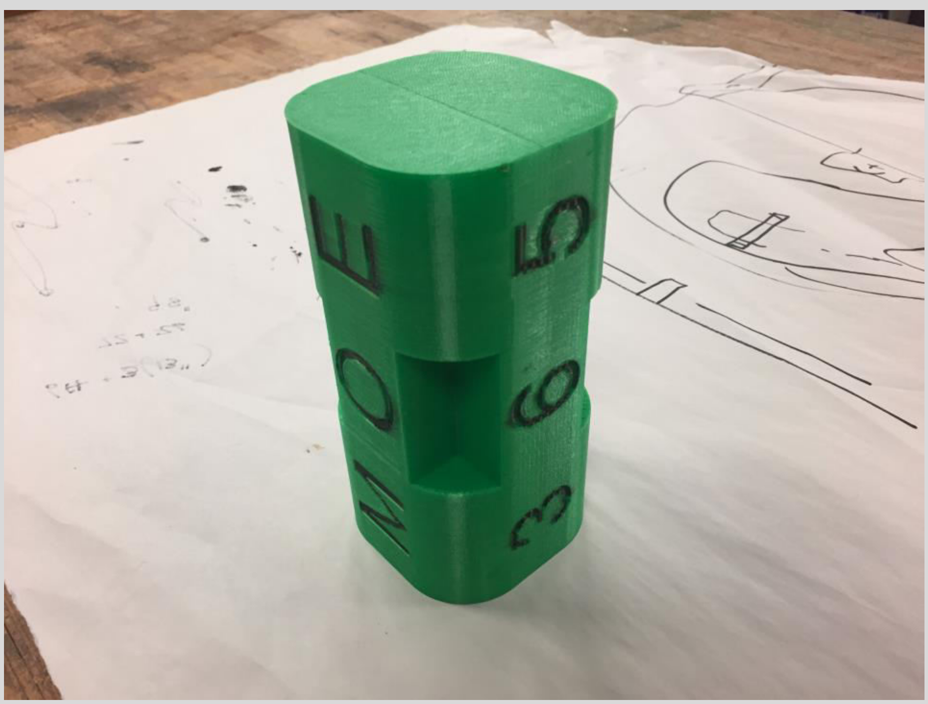
Agenda
Discuss Previous meeting

Tasks:	
Team Marker Mechanism	**Programming**
Finalize team marker	Test the autonomous programs and work on the diagonal movements within our A* algorithm.

Mechanical Accomplishments:

Batter Bot	
Tweak: Batter Bot	Paige repaired the Batter Bat so that Moe FRC could use it for their reunion later in the day.

Team Marker	
Tweak: Team Marker	Clare used sharpie to fill in the numbers and letters on our final team marker. 

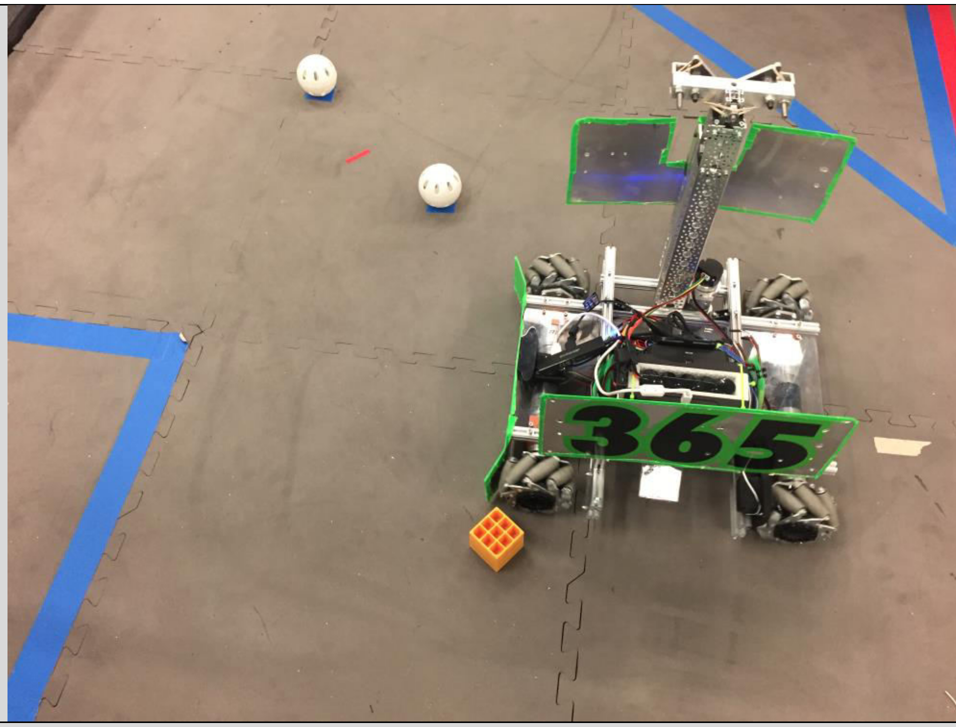
Programming Accomplishments:

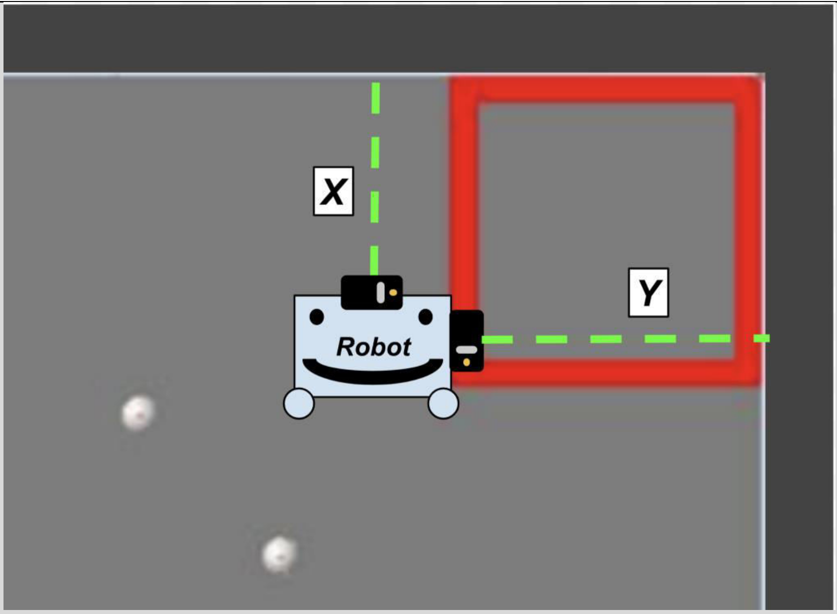
Autonomous

Evaluate: Final Autonomous

Rohan, Karthik, Jonas, and Clare first worked with Arnav to test our autonomous programs that we had been working on earlier in the week. We first focused on the depot side. After some minor adjustments, we evaluated how reliable the program was.

Part of Program	Evaluation
Lowering from Lander	The robot is very consistent when lowering and detaching from the lander. Our hanging mechanism is very sturdy and has not yet failed.
Identifying Gold Mineral	Using our neural network through TensorFlow, the robot is very consistently able to identify the position of the gold mineral. The only errors have come from incorrectly setting up the camera.
Mineral Sampling	The robot is very accurately turning and driving into the gold mineral without touching either silver minerals.
Pushing Gold Mineral to Depot	While the robot can always push the gold into the depot when the gold is positioned in the center, it is about 80% consistent when the gold is on either the right or left side.
Dropping Team Marker	The robot can drop the team marker into the depot very consistently. However, in a few cases, the team marker either starts outside the crater and is pushed in or is pushed in but dragged out by the robot’s movements.

	
Tweak: A* Algorithm	The programming team then worked on refining our A* pathfinding algorithm to more accurately move diagonally. We tested the use of encoders and in order to calculate what angle the robot should be moving at. After measuring out the proper number of encoder ticks per inch for all diagonal movements (**112**), we were able to refine the A* pathfinding algorithm to work much more effectively. There were still a few errors in pushing off sampling minerals & running into craters, but this only occurred on larger than practical tests. Within the scope of what the robot had to do in autonomous, the pathing was working well.
Construct and Test Prototype: Implement Distance sensor localization	**Construction:** For parking, we would have to move out of the depot and into the crater. The issue was that the robot was always a few inches around the ideal location for it to be after dropping the team marker despite encoder-based and IMU-based movements; in other words, our depot location precision was not to the level we needed. We would not be able to use VuMarks to localize because they were on too much of an angle for the camera to see and the distance was too great. To be able to see them would waste time. We had to act fast to stay within 30 seconds. We planned to use the A* pathfinding algorithm to get out of the depot with a pre-planned start and end (x, y) coordinate, but this would be too inaccurate due to the not optimal depot location precision. To counteract this, we decided to use two REV 2m Distance Sensors to get readings off of the walls.

	 These readings would then be subtracted or added from the walls' coordinates. For example, for the blue depot, the readings would be converted into grid units of 2 inches, so an X reading of 10 inches would be 5 grid units. This would be subtracted from our value of 72 grid units, so the overall value would be 67 grid units. The same process is done for the Y, and the robot is now able to localize off of the wall with more accuracy than blindly estimating its location. **Testing:** There was a unique error with the distance sensors. They sometimes gave wildly inaccurate values in the range of around 1000 inches. These values were clearly wrong, and our robot would not be able to localize properly off of them. At other times, the distance sensors would give an unpredictable error.
Evaluate: Distance sensor localization	When the distance sensors worked, the autonomous worked well, but the distance sensors were giving errors or faulty readings more often than not. The distance sensors worked well about 20% of the time, a value far too low for a reliable autonomous. We had to tweak the program to account for this.
Tweak: Distance sensor localization	We added a fallback plan to the distance sensors that went back to our previous idea of using a blind estimate to where the robot is. If both distance sensors do not give a value between 3 and 25 inches in 5 seconds, then the fallback plan would be activated. (This was done using ElapsedTime). The fallback plan would be to use pre-programmed coordinates as the robot's starting position into the A* pathfinding algorithm, and the robot would try to drive into the crater. Also, we adjusted the starting (x, y) point for the algorithm. The decrease y-value would allow the robot to touch the wall, letting the wall help guide it to the

	crater.

Non-Technical/Discussion:

Moe FRC was having their reunion later in the afternoon, so we needed to keep the lab neat and set up the Batter Bot for them to use.

Date: Sunday, November 25, 2018

Duration: 10:00 AM – 3 PM

Sunday, November 25, 2018 Meeting

Students:	Connor	Bryan	Patrick	Rohan	Paige	Karthik
Mentors:	**Arnav**			**Mr. Prettyman**		

Agenda
Go directly into the lab

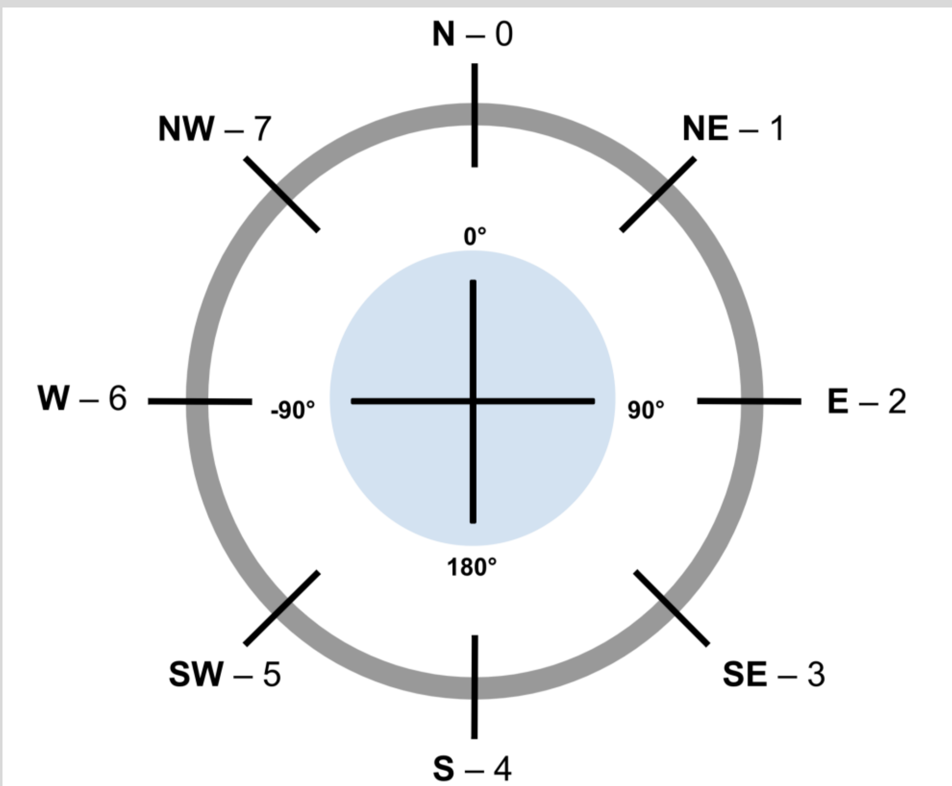
Tasks:			
Judging Presentation	**Notebook**	**MMS**	**Programming**
Finish the Judging Presentation	Finish the Notebook	Work on mounts for the motors	Implement "Rotational Symmetry" optimizations Finish control document

Mechanical Accomplishments:

MMS	
Fabricate the solution: Motor Mounts	The Programmers want to use the MMS for Parking in Autonomous. Before starting to mount the motors, I quickly mounted a long piece of REV extrusion on a servo, so they can start working on parking while I build the MMS. I mounted a 40:1 motor on the end of the Chain Drive. The motor axle went through the corner cube with a small D-shaped axle hub. This will be used to rotate the MMS. It has a motor mount at the front and the back for mounting. I mounted a REV Core Hex Motor by a using a REV beam as a standoff that connects the middle linear slide to the Motor Mount. This will be used to extend the Chain Drive

	An Aluminum plate was cut to be put in the back section of the chassis. This will be used for the motor that will rotate the chain drive. We did not want to mount it on the plastic polycarb sheet that was already on the robot because it would not be as sturdy.

Programming Accomplishments:

Construct and Test Prototype: Implement "Rotational Symmetry" optimizations	Our autonomous was sometimes going over 30 seconds, so we needed to find a way to speed up the program. One culprit was the extensive periods of strafing in the robot following the pathing from the A* pathfinding algorithm. Strafing is always slower than forwards and backwards movements, and also has more turning offset in our case. Because of this, our turn corrections were kicking in more often, wasting the time of our program. To fix this, we decided to try and convert strafing movements into forward/backward movement. To convert strafing into forward/backward movement, the robot would have to turn 90° in either direction and then go. This raised an issue, however. The pathing return for the robot did not rotate. A system was then devised where each direction the robot could travel had a numerical value. To rotate the values by a numbe of degrees, that number would by divided by 45° and added to the number. 

	For example, a direction of North (0) rotated by 90° would be: 90° / 45° = 2 North (0) + 2 = East (2) A direction of W(3) rotated by 135° would be: 135° / 45° = 3 W (6) + 3 = 9 --> 9%7 = 2 --> East (2) Any value grater than 9 would be modded (%) y 7, giving the remainder. In other words, this would wrap all values into a range of 0-7.
Evaluate: "Rotational Symmetry" optimizations	The "rotational symmetry" resulted in a good amount of time saved. The autonomous could now be run through consistently within the time limit.

Non-Technical/Discussion:

We packed for our meet on Tuesday and most of that will be repacked for the Pennsylvania Qualifier on Saturday. We considered and discussed having an extra meeting in between (Friday from 6 – 8 PM, the night before the competition

We also finished up the judging presentation and discussed what we would present and talk about. Since we want to make our team stand out, we want to discuss the points that we feel are more special to our team while not going too deep into specifics because we only have 5 minutes to present. We decided to not spend as much time introducing our team because our Business Plan already goes into depth; we will give an overview of the team and then reference the business plan if judges want more specifics. We want to discuss more of our robot priorities (hanging and autonomous), as well as going through why our notebook and team organization is special. We will hit the big points, and leave specifics during the questions section of the presentation.

Delaware Meet at Padua Academy

Attendees: Patrick Tiamson, Bryan Tiamson, Karthik Kona, Ian Picho, Connor Nagle, Clare O'Dwyer, Rohan Kanchana, Jonas Ho

Date: November 27, 2018

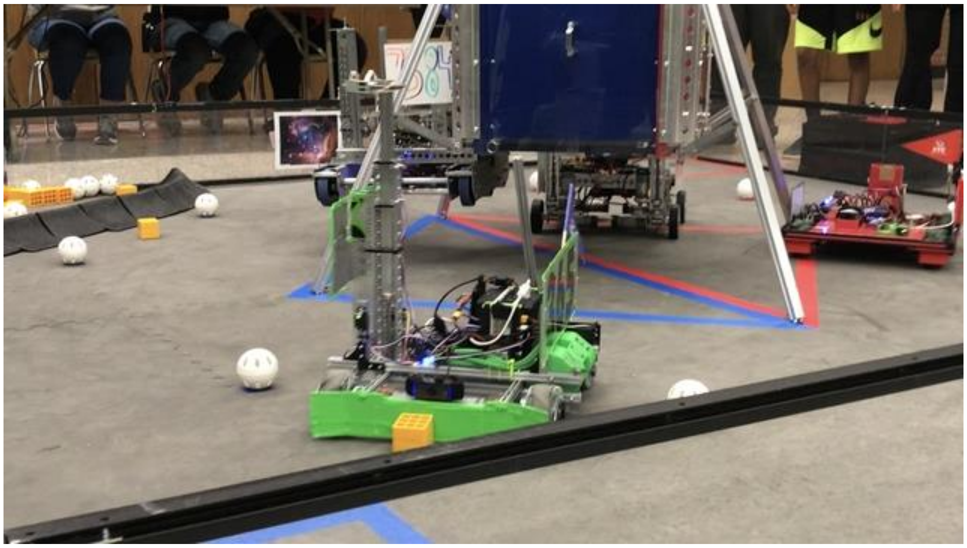
Time: 5:00-8:00 PM

Event Description

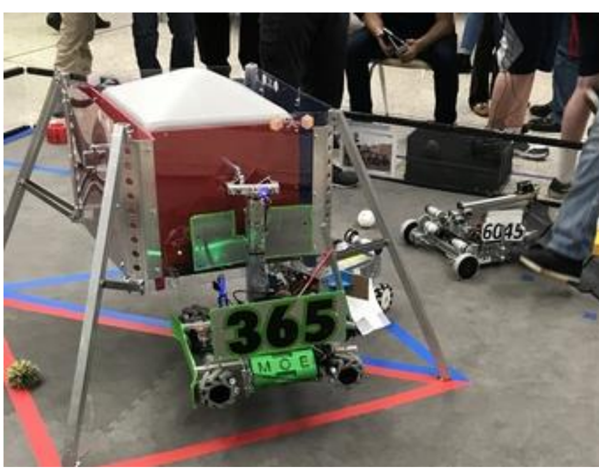
MOE 365 FTC was very excited to attend a meet at Padua Academy. While there, we had the opportunity to discuss with other teams about various strategies and ways to accomplish the missions. Many were interested in our hanging mechanism, and we were very happy to hear their thoughts on using a linear actuator with a carabiner-like clip on the top. We also had the chance to refine our autonomous and add a stick on a servo that we could lower down in order to have a better chance to score points for parking in the crater during autonomous.

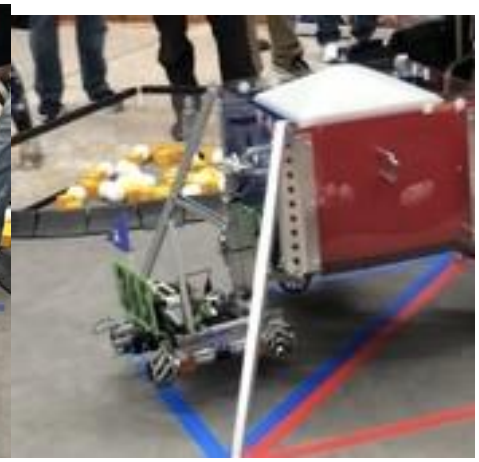
Before the matches, we also got to experience what robot inspection would look like. We learned of the new system of self-evaluation: teams now submit a pre-completed form instead of doing everything during robot inspection. Also, we were shown the new system for sizing checks. Finally, we learned about REV grounding strips, and we verified that our robot and team marker were both in the proper size.

Then, we were invited to participate in five qualifying matches. We rotated drivers and gained valuable experience preparing our robot for a match, switching between autonomous and TeleOp programs, presenting our robot for inspection, discussing with refs, and communicating with our alliance partner.



In one match, we forgot to reset the webcam, meaning our autonomous program did not run properly, and in another, our robot shut off after coming into contact with our alliance partner. These were both important learning experiences that we will use to improve for future competitions. We were very happy to be invited to participate in a final championship match in which we partnered with Ozone against teams Hiller Instinct and Flaming Phoenix. We were able to use our hanging ability and autonomous program to earn our alliance enough points to win. We also got footage that we can use as B roll for the promote video that we plan on making!



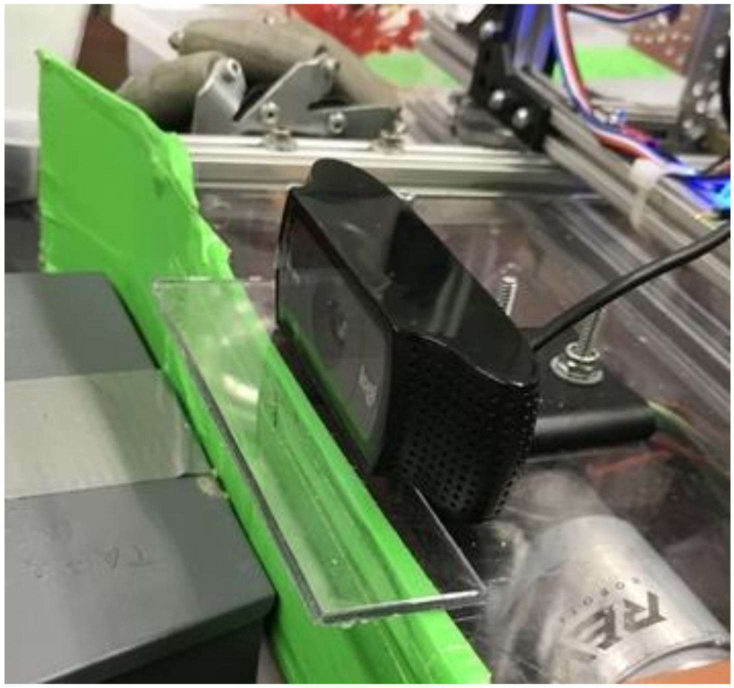


We also did the MOE Cheer a lot! Gotta show that team spirit!

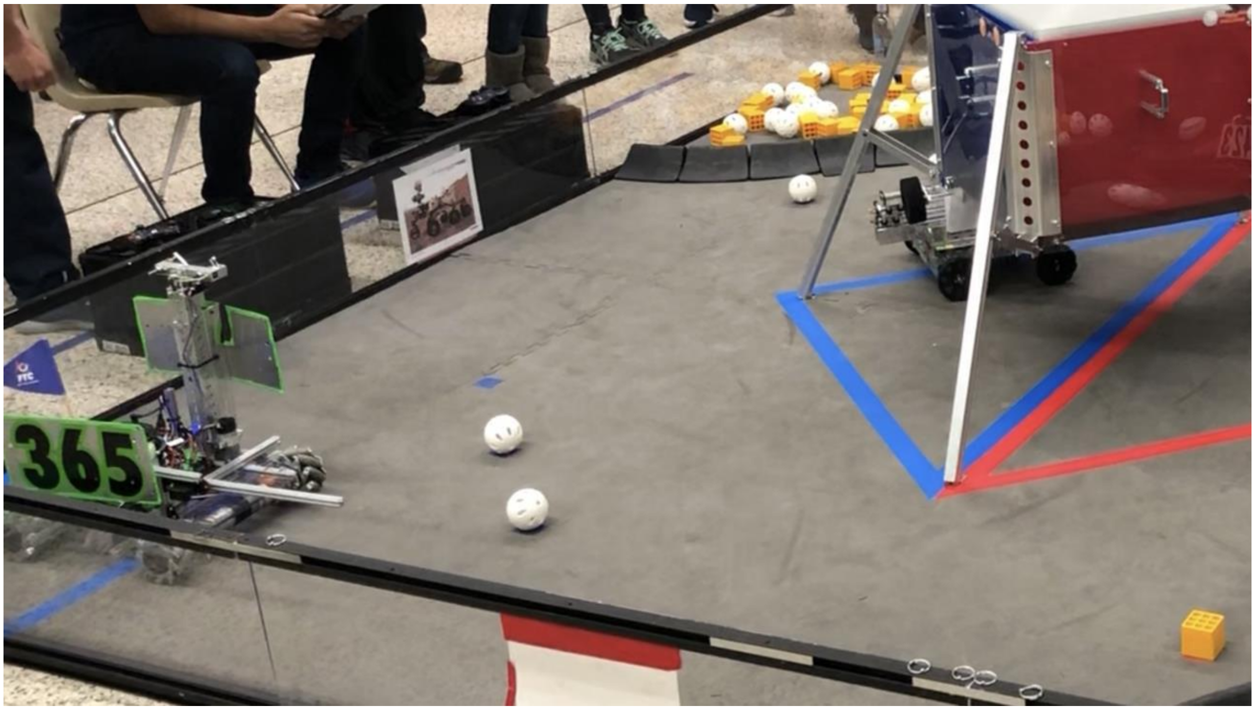
Reflection

This was a very valuable experience for our team. Besides gaining experience, showcasing the MOE cheer, and seeing what a competition setting would be like, we learned many crucial lessons that will help us to improve in the future. We look forward to refining our programs, tweaking our robot, and attending more competitions in coming weeks.

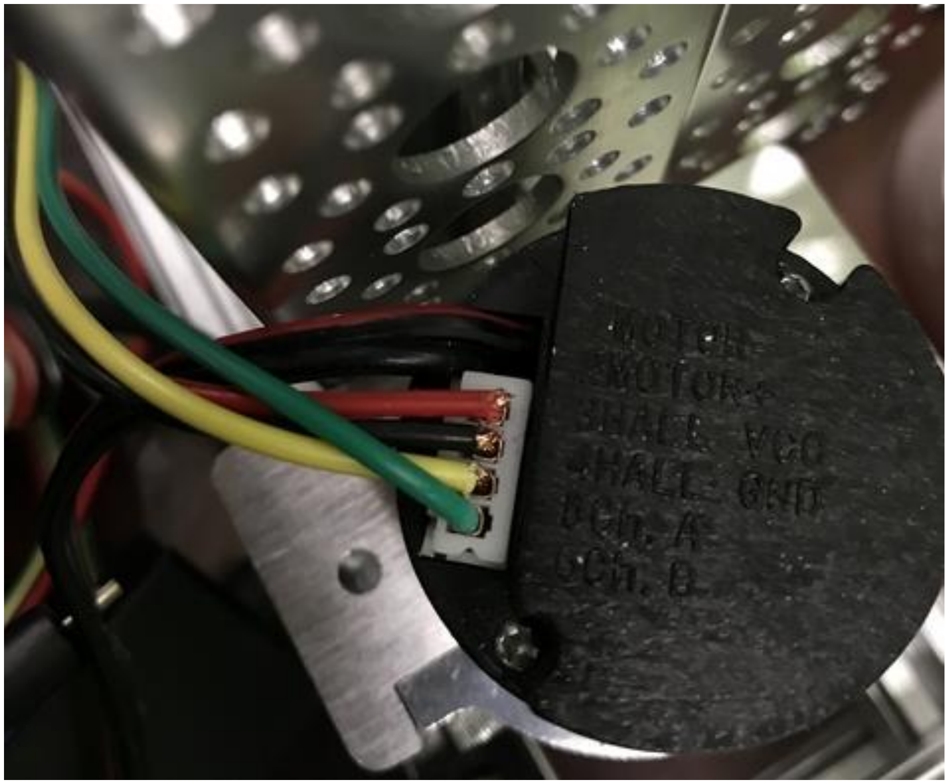
We did have some notable errors throughout the meet, so we plan to fix them in our meetings to come. First, our camera is not fully hard-mounted in place. Although the base of it is screwed on, there is an angular degree of freedom (pitch) that creates inconsistency. Our only method of correcting the camera is a small shim that we place underneath the camera before every match to make sure it is in the same place. This is not very reliable, and our camera did not detect the minerals in one of our matches.



Also, in autonomous, the robot did not reliably make it to the crater. The A* algorithm uses the encoder ticks to map its location, but if it gets stuck, the algorithm gets confused. We should implement the use the distance sensor and track its time derivative to see if we're actually moving, and then relocalize to find our actual location.



Next, the insulation around the encoder wire of the LLMS is starting to fray, so we're hoping we patch it up in the next meeting to avoid errors.


MOTOR
MOTOR+
HALL VCC
HALL GND
Ch. A
Ch. B

Date: 11/29 – 30/18

Duration: 5 PM – 9 PM & 6 PM – 8:30 PM

Thursday & Friday, November 29 – 30 Meeting

Students:	Patrick	Bryan	Rohan	Karthik
Mentors:	**Mr. Prettyman**	**Arnav**	**Zach**	

Agenda
Go straight to lab

Tasks:		
Autonomous	**MMS**	**Tele-OP**
Finish All 4 Autonomous	Finish and Mount MMS	Program MMS

Mechanical Accomplishments:

MMS	
Fabricate the Solution:	We screwed the Tennis Ball collector at the end of the rotating arm and created a mounting plate for the MMS. We put two motor mounts on the mounting plate to stably mount a single 60:1 motor. We mounted the mounting plate to the front of the chassis and mounted the rotating arm directly onto the 60:1 motor

Programming Accomplishments:

Autonomous	
Tweak:	The Blue Crater and Depot Autonomous were not always perfect. We ran many trials and changed encoder values and angles to increase reliability. We also fixed some A* errors with pathing. We messed around with the values for the radius for the robot, and some changes to the map of the A* field. We also temporarily manual hard-coded part of the path, specifically around the sampling minerals. A* would sometimes miscalculate the distance in between the robot and the sampling mineral, and thus accidentally knock-off a silver mineral.

Fabricate the Solution: Red Crater Autonomous	For Red Crater Autonomous, we reused much of the code found in Blue Crater Autonomous since the autonomous pathing is identical for each one. The only major items we had to change for the Red Crater Autonomous were the points used for the A* Pathfinding Algorithm. To go back to the crater in Red Crater autonomous, we have to change the point to (36,6). After this tweak, our code for the Red Crater Autonomous was complete.

Tele OP	
Fabricate the Solution: Program MMS	The MMS has two motors on it, the lift and the rotational hammer. For the lift, we programmed that the joystick value controls the speed of the lift which was very simple. The rotational hammer was a bit more difficult We wanted different positions because if we ran it off of power, we could easily break it. We created an encoder tick to angle function, so we can use angles in our code and math. We used the DPad to program up and down positions for the hammer

Non-Technical/Discussion:

We discussed what we need to prioritize for judging. We believed that there were many things that we learned from last year that greatly improved, such as Autonomous (starting earlier), Simple Design, and Notebook. We wanted to make sure these were prioritized in the presentation.

Hat Tricks Qualifier

Attendees: Patrick Tiamson, Bryan Tiamson, Karthik Kona, Ian Picho, Clare O'Dwyer, Rohan Kanchana, Jonas Ho, Katy Gu, Connor Nagle

Date: December 1, 2018

Time: 8:00 AM - 5:30 PM

Event Description

MOE 365 FTC was eager to attend their first qualifier of the 2018-2019 season at Hatboro Horsham High School in Horsham, Pennsylvania. The busy day was one of the highlights of our season and will be invaluable as we progress towards more competitions in the future. Attending this event gave us a wealth of opportunities and experience that we will remember and look back upon for the remainder of the season.

Attending my first FTC competition was an exciting and memorable experience. In the morning, we set up our table in the pit area and immediately began to talk with the teams around us. Everyone was enthusiastic for the day ahead and wanted to hear about what our team had planned. We demonstrated our lifting mechanism to multiple other coaches and teams, and we were happy to hear that several of them would consider drawing inspiration from our design when working on their own robots.

After testing our autonomous program a few times, we went in for our judging session. We were excited to demonstrate what we had completed this season and wanted to show all of our progress for the judges to see. While the presentation went well, we felt that we had not fully represented our outreaches and notebook. We will continue to practice and improve our presentation for future competitions.

One mechanical change we made during the competition was adding an arm with a pipe on the end which would be able to pick up minerals and drop them off. We wanted to have a mineral system for the competition, so this was our fast attempt at making one. However, this quick design was ineffective and even got in the way of one of our hangs. This experience taught our team that we should plan ahead and make sure to test all of our mechanisms before we put them on the robot, as they may end up being more hindering than helpful.

After the opening ceremonies, we watched the first matches. We tried to always have a few people watching the matches in order to write down notes for scouting while the rest prepared the robot for our next match. While the competition was certainly chaotic at times, it was energizing to talk with our alliance partner, strategize before matches, and perform the MOE cheer!

After the qualifying matches finished, we talked with other teams in preparation for alliance selection while also fixing our autonomous program. Our robot was getting confused by the yellow gym floor when looking for the gold mineral, so we had to adjust our program to fix the issue at the last minute. Ultimately, we were happy to be chosen by LanBros in alliance selection.

The final competitive matches were definitely the most exciting part of the day. The level of competition was very high and all teams were performing extremely well. Our team was elated to be a part of such a competitive series of matches and we will remember this experience for the remainder of the season.

At the closing ceremonies, we were honored to be given the Control Award and to be chosen to move on to the Pennsylvania state tournament later in the year. We will continue to improve our robot in order to be ready for this competition.

Overall, this competition was a new and exciting experience. For me, it was a wonderful introduction to First Tech Challenge and I will certainly remember it for years to come. Our team also learned many valuable lessons, gained driving and judging practice, and had the opportunity to talk with other teams about how they approached this year's game. Our team will remember this competition and what we discovered for the rest of the season.

Date: Tuesday, December 4, 208

Duration: 6:00-8:30 PM

Tuesday, December 14, 2018 Meeting

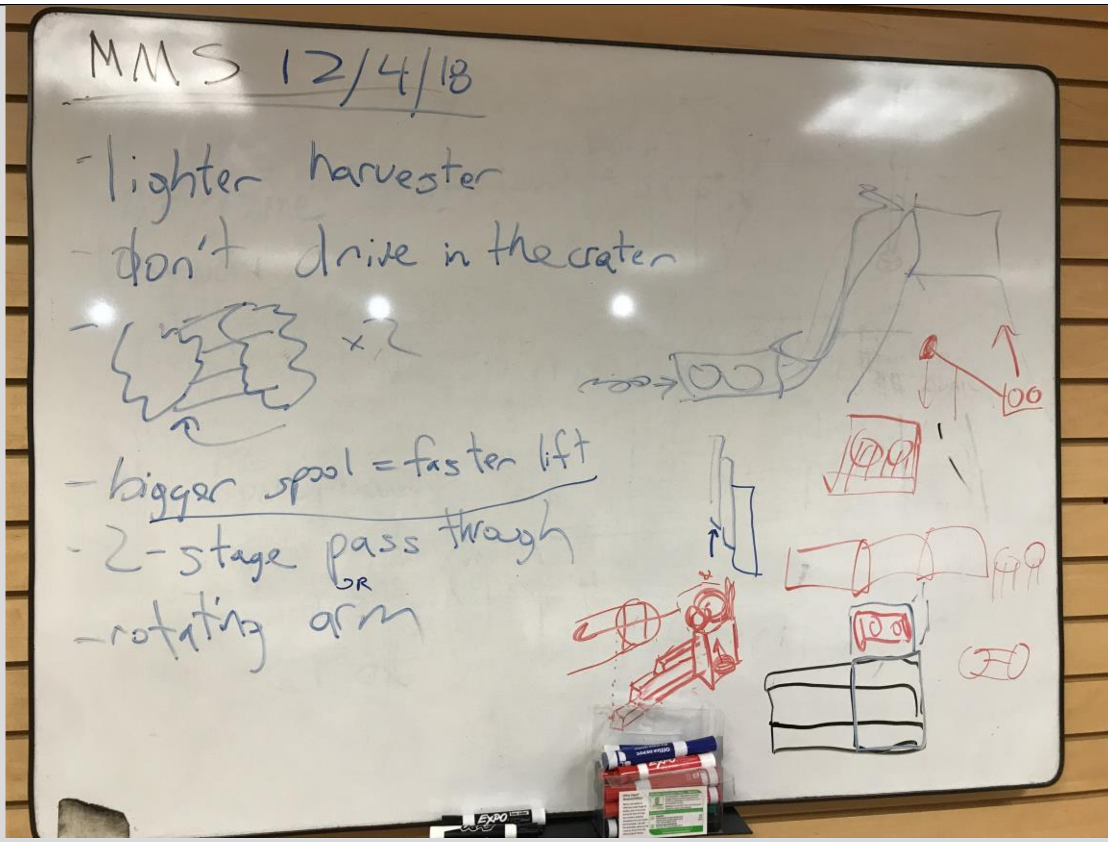
Students:	Bryan	Connor	Patrick	Clare	Paige	Rohan	Jonas	Katy
Mentors:	**Mr. Prettyman**	**Mr. Price**	**Dave**					

Agenda
Discuss the competition and key learnings
ırt planning on ways to improve the robot

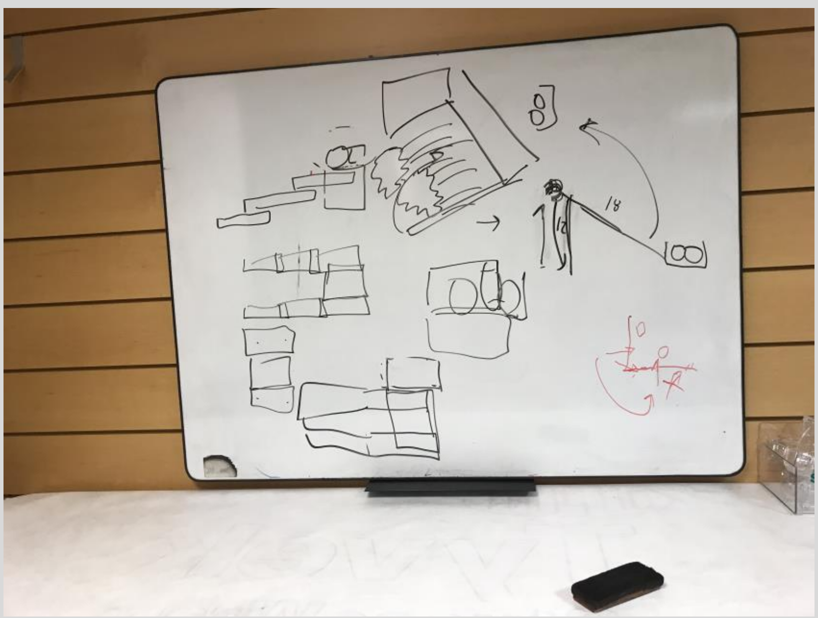
Tasks:
MMS
• Generate ideas for the Mineral Management System

Mechanical Accomplishments:

MMS	
Generate Concepts: **New Harvester**	Concepts for the Mineral Management System: (12/4/18)



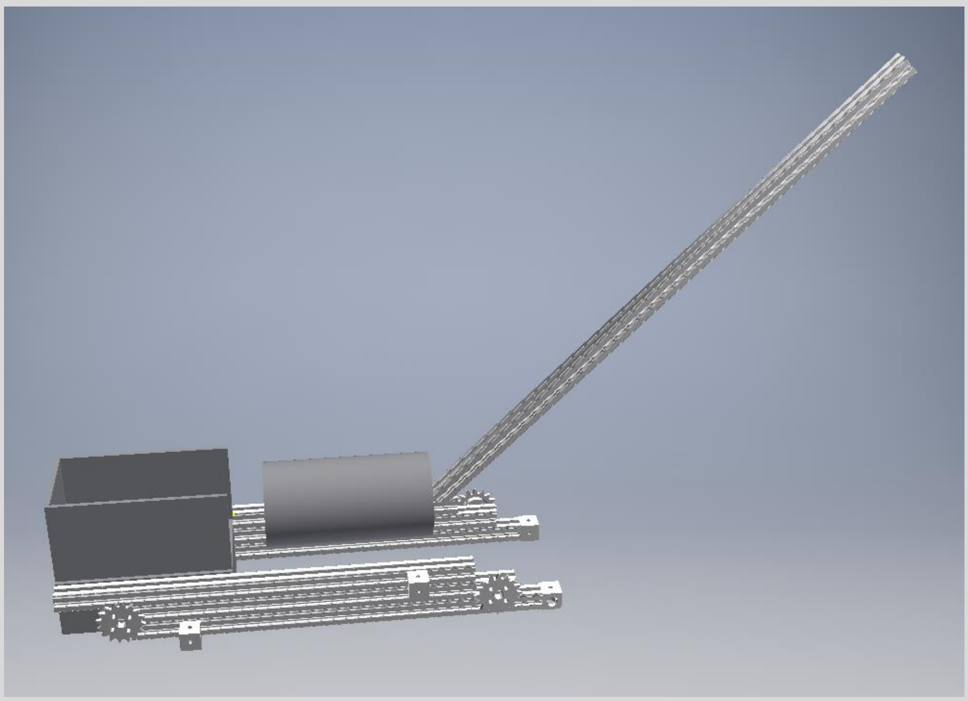
- Lighter harvester
- don’t drive in the crater
- O=O x2
- Bigger spool = faster lift
- 2-stage pass through
- Rotating arm



We went to try to sketch what a new harvester might look like and how it will function

<table>
<tr><td>Generate Concepts:

Constraints for design</td><td>We wanted our solution to fit under certain requirements or criteria to start narrowing down our choices:
1) Score from both corners
2) reach over the crater
3) Harvest both minerals
4) Speed (15-20 minerals)
5) Reliability over scoring possibility

We want to have an MMS that fits under these criteria BY DELAWARE STATES</td></tr>
<tr><td>Develop a solution:
basic CAD</td><td>Connor and Bryan started making CAD for the MMS, with a modular design so we can insert any kind of harvester we want.
This design will be presented in the next meeting as we continue to brainstorm new ideas.
</td></tr>
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Non-Technical/Discussion:

LESSONS LEARNED FROM HAT TRICKS PA QUALIFIER:

- **Overall Team Presentation (during judging and in the pits)**
  - **Presentation needed to be cleaner**
    - **Delivery did not represent our content (We need a better delivery to fully demonstrate our team's merits)**
  - **DON'T FORGET THE NOTEBOOK (and control document)**

        - **Not the best impression on the judges**
    - **Didn't say the MOE Cheer**
        - **This is not the most important but it'll lay a solid impression for judges**
    - **Wanted a focus and an impact to our outreach**
        - **Many judges asked us about outreach, but we did not have a specific focus to talk about**
    - **We should have a solid poster board provide visuals for teams and judges**
        - **Talking about outreach easier with visuals in the pits**
- **Notebook**
    - **Needs lessons learned and reasoning behind choices**
    - **More CAD in the Notebook**

Date: 12/8/18-

Duration: 9:00 AM – 2:30 PM

Saturday, December 8, 2018 Meeting

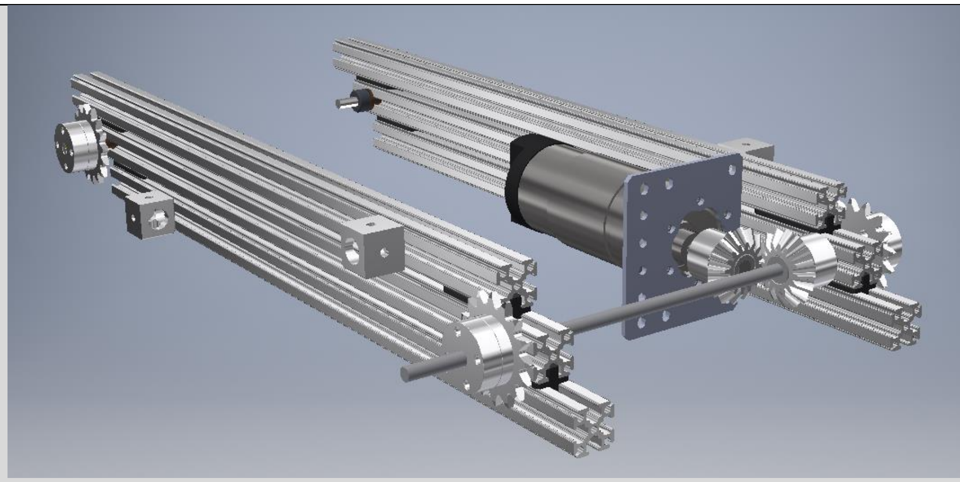
Students:	Connor	Bryan	Patrick	Marcus	Katy	Jonas	Rohan	Karthik
Mentors:	**Mr. Prettyman**	**Zach**	**Arnav**					

Agenda
Previous meeting discussion

Tasks:	
MMS	**1st Chassis**
Discuss MMS Designs Start CAD'ing ideas	Remove old MMS
Programming	**Shirt design**
Start training neural network	Shirts came in! Start planning shirt design

Mechanical Accomplishments:

MMS	
Generate Concepts: Showcase Previous Meeting's CAD	Bryan and Connor worked on CAD on the previous meeting and showcased it today to show the team a possible solution for harvesting and scoring. This CAD can be found in the previous meeting (December 4th 2018)
Develop a solution: Improved CAD	Connor and Zach worked on improving the CAD. They only finished the linear slider part of the mechanism, but can add the harvesting and lifter later.

	 This design uses our previous chain drive from earlier this season, which will be beneficial when tring to remake it.

Programming Accomplishments:

Autonomous	
Evaluate Solution: Mineral Detection	The Autonomous sampling routine, that determines whether the gold mineral is on the left, center, or right, would report the incorrect position. The TensorFlow neural network given in the SDK would confuse the tape on the ground and other yellow/brownish noise in the background with actual tape.
Develop a Solution	We decided that the best solution would be to create our own Neural Network, based off the already built-in helper methods for Tensor flow included in the FTC app.
Construct and Test Prototype	The first step was to take images to build our detection system. We took more than a hundred pictures in total. We started our robot as if we were doing a normal autonomous run, but stopped it right as it got to sampling. We took pictures: • with the gold mineral in all three position's (left, middle, right) relative to the two silver gold minerals  • at all four starting positions. • With random obstructions in the background

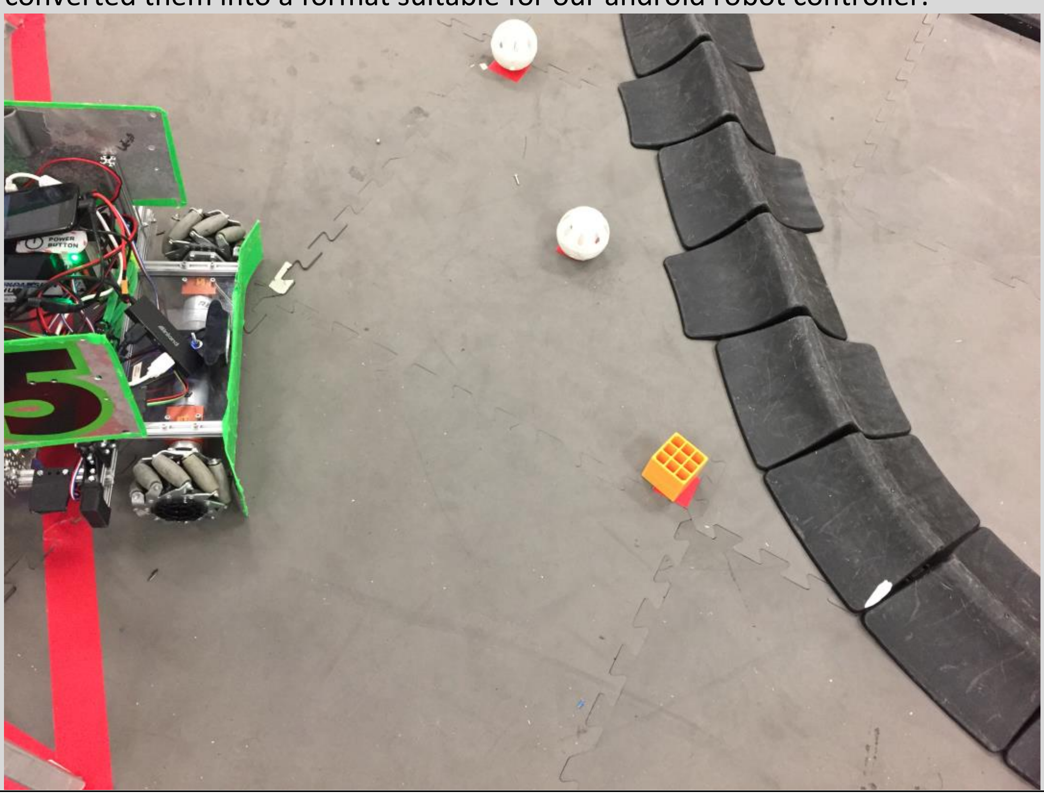
Picture of random obstructions in background

We imported the pictures into photoshop, and batch colorized them.

- We created a version of each image that had more/less brightness, to compensate for different lighting situations that may be experienced.
- We also made warmer/cooler version of each image, to compensate for different types of lighting that may be experienced. In the end,

we had over 900 images.

We took all the images, and downscaled them to a size that would suitable for a neural network. Finally, we built a neural network based of the images, and converted them into a format suitable for our android robot controller.



Non-Technical/Discussion:

Buttons	
Generate Buttons	We used the printer to print unikeesha pictures to make buttons of. We used the button machine to make the buttons. We also tried to print MOE DEW buttons but the images were too large when we printed them out. We will fix this in a future meeting.

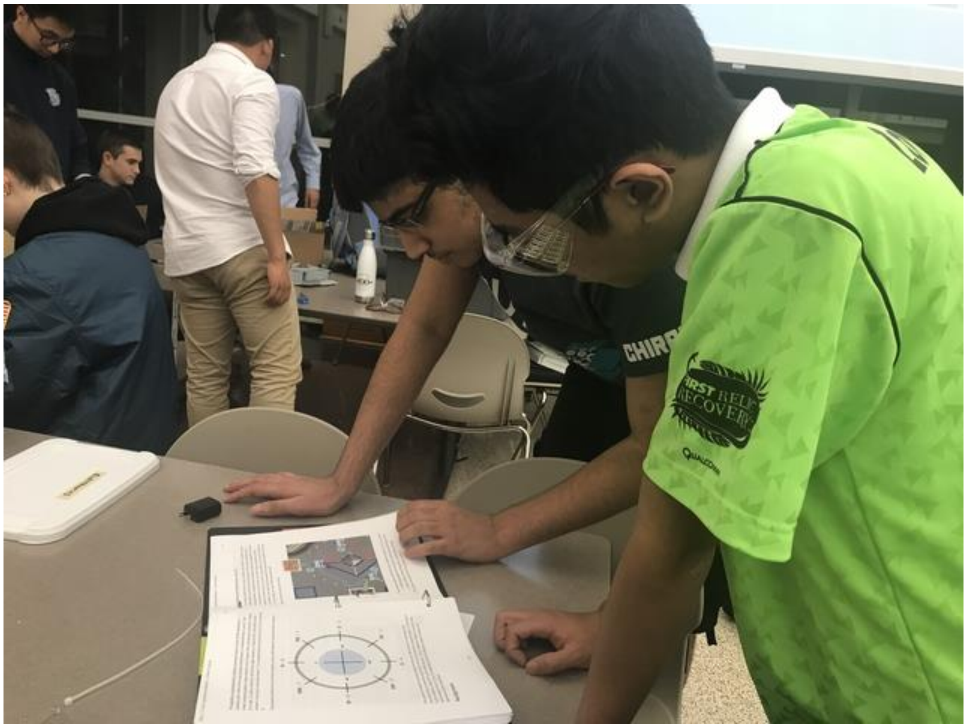
Archmere Academy Robotics Meet

Attendees: Marcus Scena, Connor Nagle, Patrick Tiamson**, Bryan** Tiamson**, Rohan** Kanchana**, Jonas** Ho**, Paige Morril, and Clare O'Dwyer, Ian Picho, Karthik** Kona

Date: 12/13/18

MOE FTC 365 went to the Archmere Academy Robotics meet for our second of two Delaware meets that we need to do in order to get into the Delaware State Championship. The meeting is for participation and teams from Delaware and Pennsylvania could compete in. There were 10 teams and 13 matches. We competed in 5 of them. We had several different drivers whom were Connor, Ian, Jonas, and Patrick. Overall, we came in 2nd place. We were teamed up with the 3rd place team and went against the 1st and 4th place teams and won it.

Final's Match Score 294-66



Showing our Control Document to Team 7244 Out of The Box

We could still work on our autonomous, for example we have two autonomous programs made and when we were placed on the blue team it wasn't the best and our robot could move during autonomous. But worked during tele-op. The red one on the other hand worked a bit better and completed the tasks the we have designed it to. Due to this we had an easier time on the red team rather than the blue team.

Overall our team spirit was very well. We have helped out a Girl Scout team named "Juliet's Revenge". They had trouble with their codes on running the robot. We had our small team of coders to help them out, and in the end their robot worked, it finished all other their tasked assigned and they thanked us for taking our time and helping them out during that night. Next was our cheer. Many of the teams that showed up on that night were lacking somewhat on their team cheer. We have done our cheer and got many people to pay attention to our team. After doing this other teams noticed and cheered in as well. So in conclusion our team did very well to the people that were there, and we were very useful to several of the teams that were there and got their robot up and running in the end.

Date: 12/15/18

Duration: 9:00 AM – 2:30 PM

Saturday, December 15, 2018 Meeting

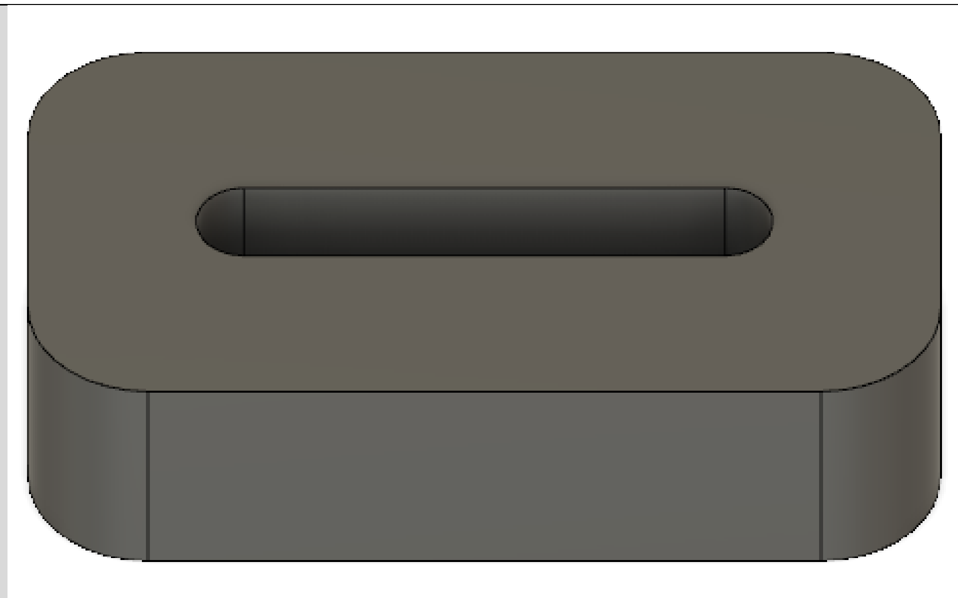
Students:	Patrick	Bryan	Connor	Ian	Rohan	Katy	Jonas	Clare
Mentors:	**Mr. Prettyman**	**Zach**						

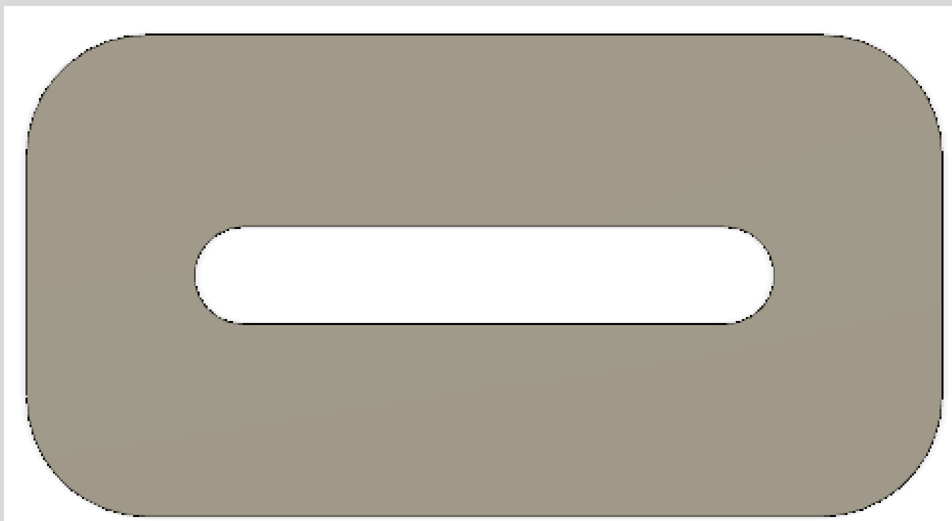
Agenda
Discuss Friday Meet

Tasks:		
MMS	**Programming**	**Camera Mount**
Work on Harvester and Work on Lift	Refine mineral identification to eliminate sources of error	Finish CADing and 3D print the camera mount Ian Marcus

Mechanical Accomplishments:

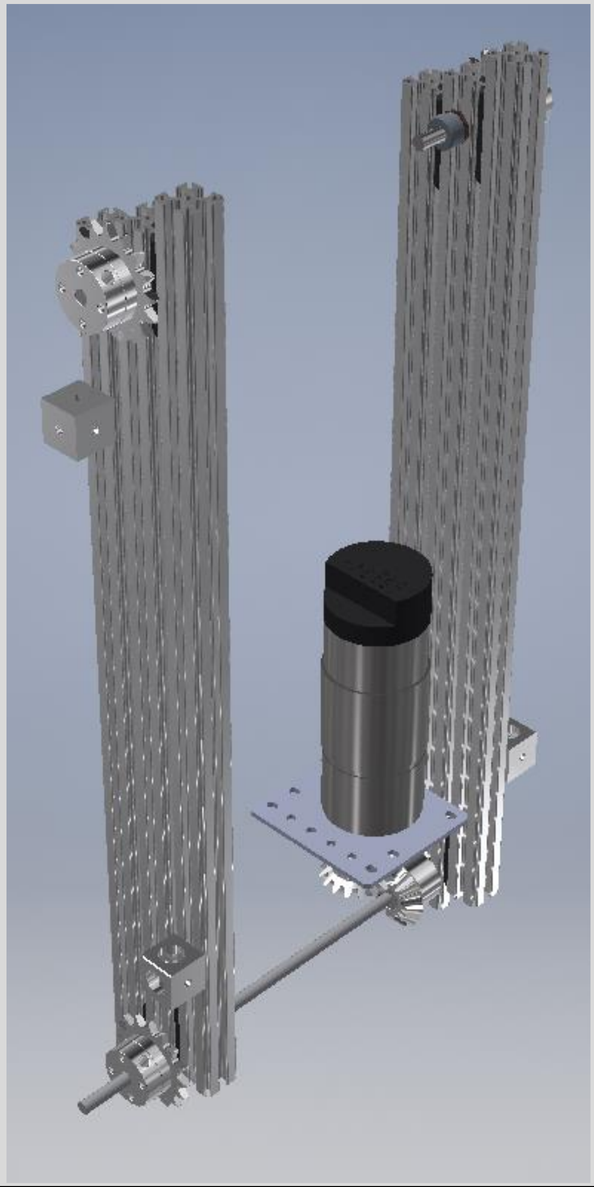
Camera Mount	
Generate Concepts: Camera Mount Block	• After Ian showed the Zach the camera mount he CADed on Tuesday December 11th, Zach suggest he should CADed a camera mount that will mount on the base of the camera and would be secured by the screwson the camera base • It is a rectangle that has an inner slot for the screws that are securing the base of the camera can go through. • The Dimensions of the piece are 1 in. wide by 1.9 in. long by 0.5 in. tall • The model has 0.1 in. fillets on the inside and 0.25 in. fillets on the inside





Construct Prototype: Camera Mount Block

- After Ian showed Zach the finished CAD model of the camera mount block, Zach told Ian to print it with 2 perimeters, 5 to 10 percent infill and 0.35 mm layer height.
- Ian put the CAD file in Slic3r and put the print setting as 2 perimeters, 10% infill, Rectilinear infill pattern and 0.35 mm layer height.
- Ian and Marcus turned on the Prusa i3 mk2 3d printer and got the tap on the print bed ready to be printed on.
- Ian preheat the printer extruder to 255**°C and the print bed to 60°C.**
- Ian made a .gcode file of the Camera mount block with the setting he put for it for the 3D printer to print it.
- Then, Ian cleaned off the extruder of filament with needle nose pliers.
- After that, he started the print.
- After the print was done printing, Ian screwed the Camera mount block onto the base of the Logitech camera with the screw that mounted the base of the camera to the robot.

MMS	
Develop a solution: CAD for lift	Connor Made some CAD for the scoring lift. 

Programming Accomplishments:

Autonomous	
Evaluate: Identifying the Gold Mineral	The programming team had been experiencing some issues with identifying the gold mineral. During competitions and meets, the robot had sometimes been mistaking different objects for the gold mineral. Possible sources of error we identified included: **For the Gold Mineral -**