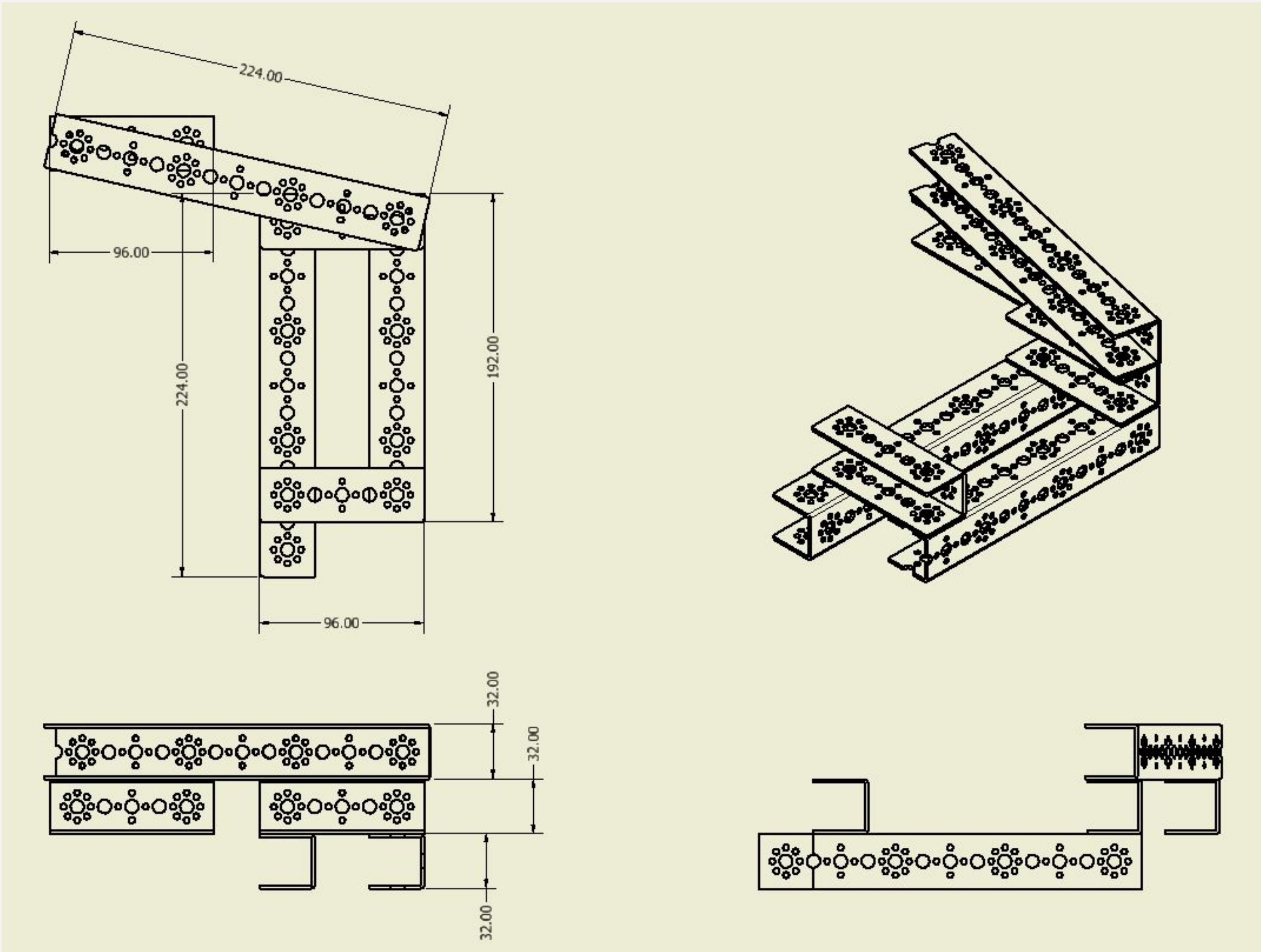
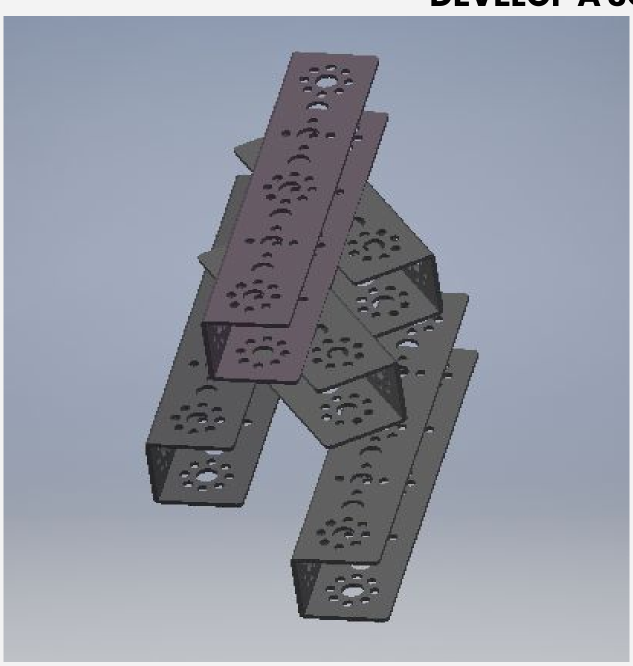
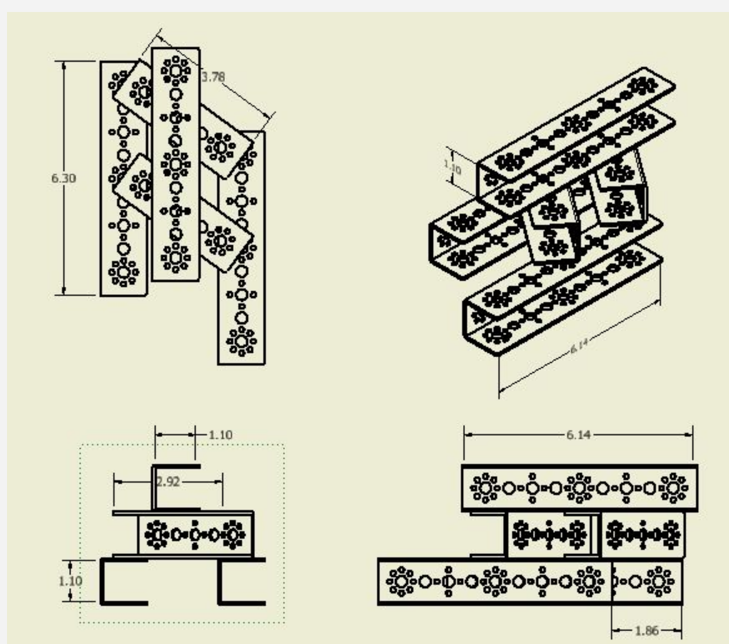


DEVELOP A SOLUTION: CLAW CAD

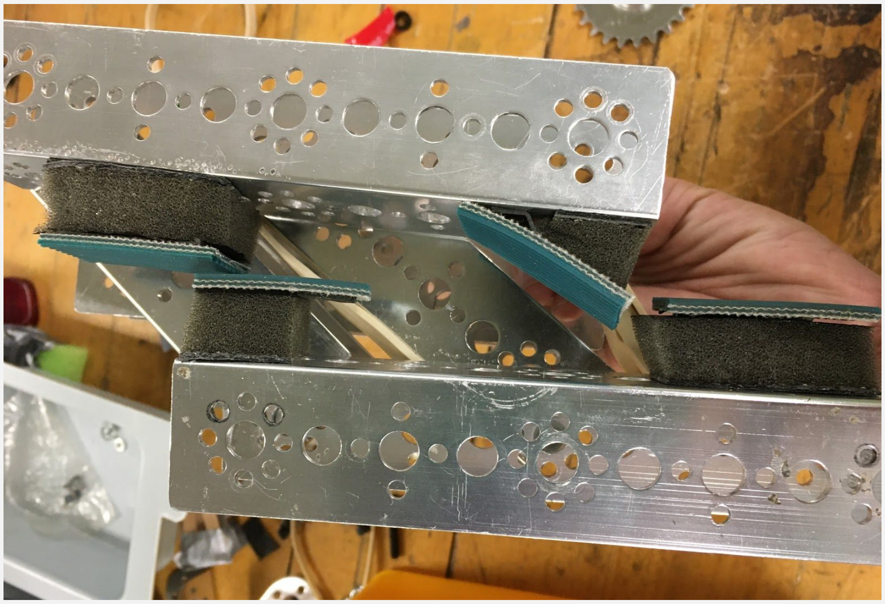




CONSTRUCT AND TEST A PROTOTYPE: CLAW DESIGN

While the CAD for the four bar's extension mechanism was being created, Jonas, Ian, and Suraj worked on testing the lower claw part of the design. One of the issues we ran into from last week was how well the claw was able to grip the stone. Rubber bands, rubber strips, and other gripping materials did not work very well, and we realized that this was because the Stone's studs are angled inward slightly.

To adjust for this, we added a small square of flexible foam underneath the rubber gripping material.



This worked much better than before. The flexible foam molded to the shape of the Stone and held the Stone securely while being rotated or shaken moderately, but the Stone fell when the device was shaken too much. Another alternative could be to 3D print a piece that has the same angle as the Stone's edge.

After this, they moved on to setting up chains and a servo to be able to test the

After testing the rubber band strength, we found that it took 7 pounds of force to open the claw enough to clamp onto the Stone. However, the servo strength is only 58 ounces per inch. This means that we would need to either use significant gearing or a motor.

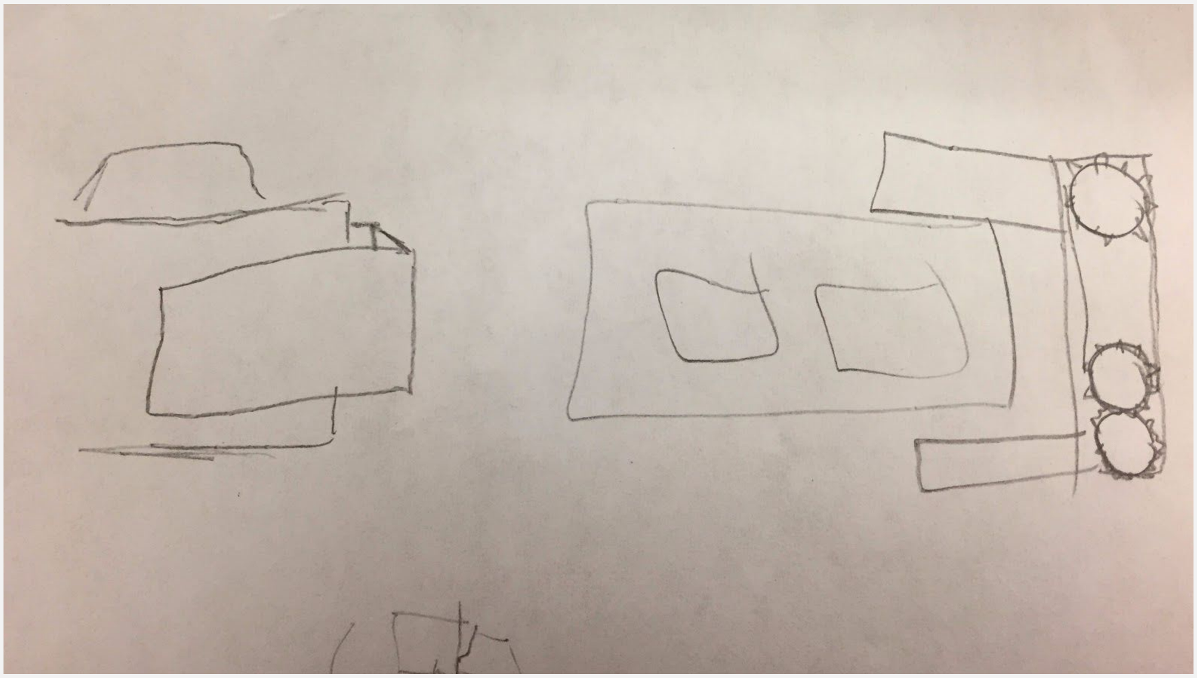
This means that while the four bar design is plausible and has a lot of potential, it may not be the best solution.

We do not want to sacrifice a being able to securely grip the Stone for the ability to maneuver it. While having a design that only grips the top of the Stone is ideal for being able to Stack quickly, it may not be consistent enough or require too much force to operate.

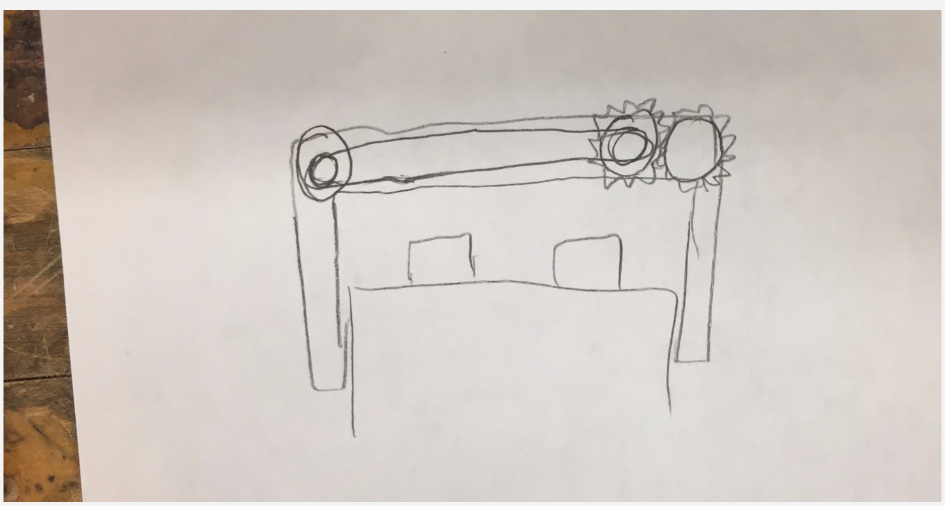
CONSTRUCT AND TEST A PROTOTYPE: FOUR BAR CLAW DESIGN

This led us to pursue another design idea. We were previously trying to focus on designs that gripped from the top and wouldn't interfere when forming side by side stacks. However, when discussing with Andrew and Arnav, we realized that we want to widen our design approach.

- The design that we thought would work the most quickly and reliably would be a simple side grabber, as shown below. We initially thought this idea wouldn't be plausible because it wouldn't be able to function when there was a Stone on the right or left of where the new Stone was being stacked.



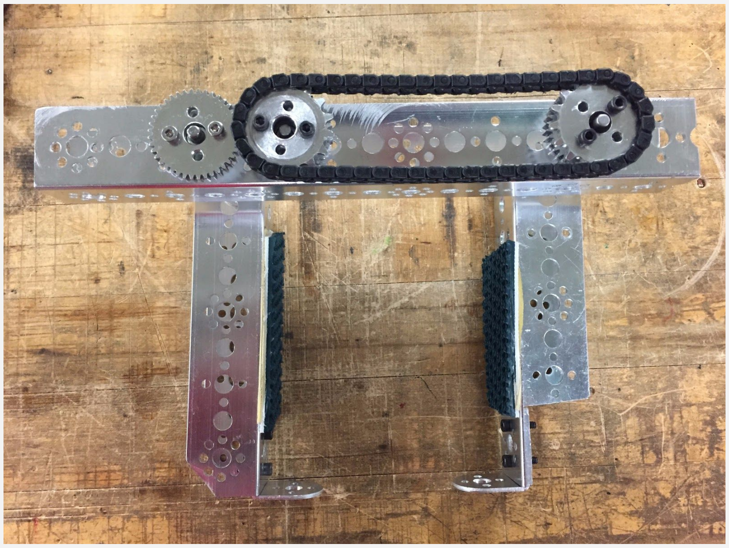
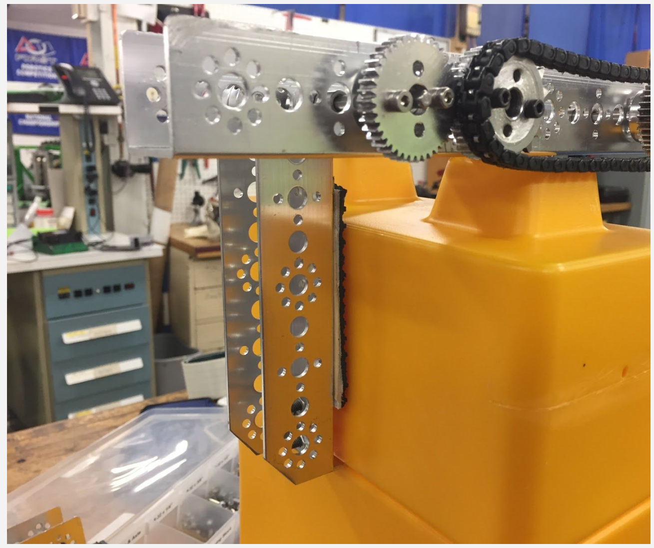
- However, when talking to our mentors, we realized that it may be worth it to pursue this design because we could modify it to, instead of grabbing from the right and left side, have the option of alternatively grabbing the stone from the front and back edges.



- This would allow for the design to stack regardless of whether we were stacking side by side, vertically, or horizontally. It allows for the more secure right and left claw to be used whenever possible, but also gives us flexibility in stacking side by side and using the front and back claw.

- The design would likely use two servos and be spring loaded with springs or rubber bands.

Jonas and Suraj worked to prototype this design.

We used a center gear attached a servo and connected it to one side with a gear and to the other side with a chain and sprockets. This would allow for both sides to be powered by one servo and to move simultaneously. We then lined the inside of the claw arms with rubber and added small part to the bottom of each so that the Stone would be held securely.

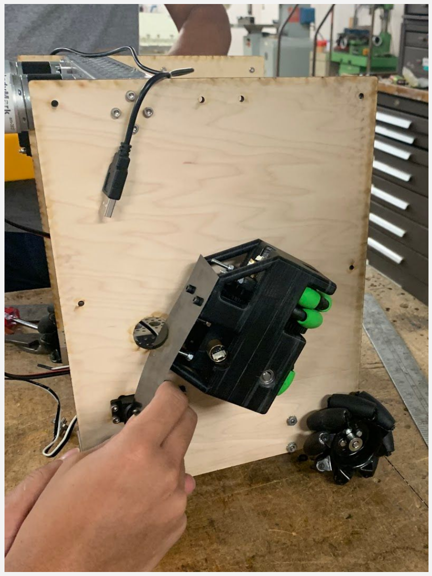
We then tested the design's stacking abilities. We didn't have time to attach the servo, but the Stone seems to be held very securely and can be fully moved into its stacked position before the claw arms rotate outward.

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	**Fabricate and Integrate**	Tweak & Evaluate

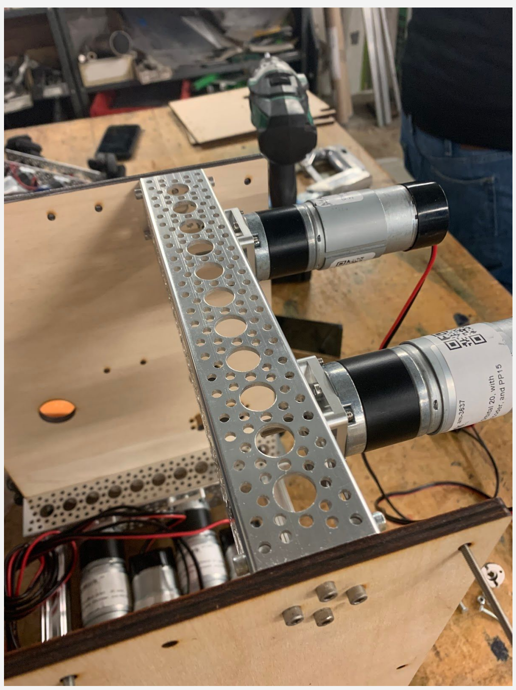
ODOMETRY & CHASSIS

FABRICATE AND INTEGRATE: ODOMETRY MOUNTING

We had to manufacture the mount for the spring steel to servo. This was done by getting one of the REV L-bracket Motor Mount that uses the same hole pattern as the servo horn. We trimmed it to fit the design and used the trimmed portion to create hole pattern on the spring steel. The servo was mounted from pre-cut holes into the wood

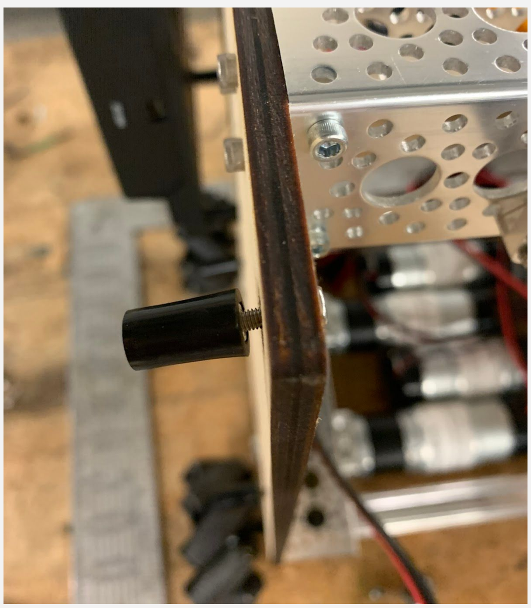


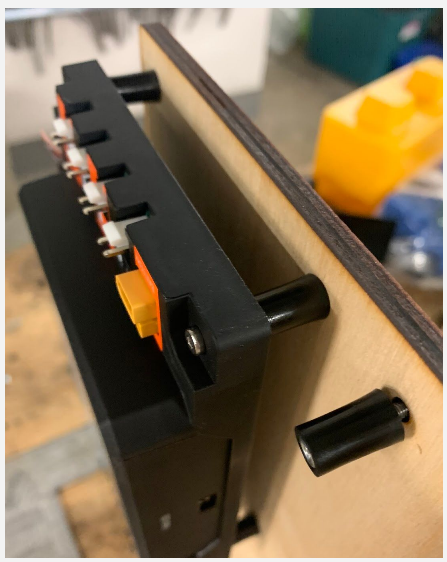
FABRICATE AND INTEGRATE: CHASSIS SUPERSTRUCTURE

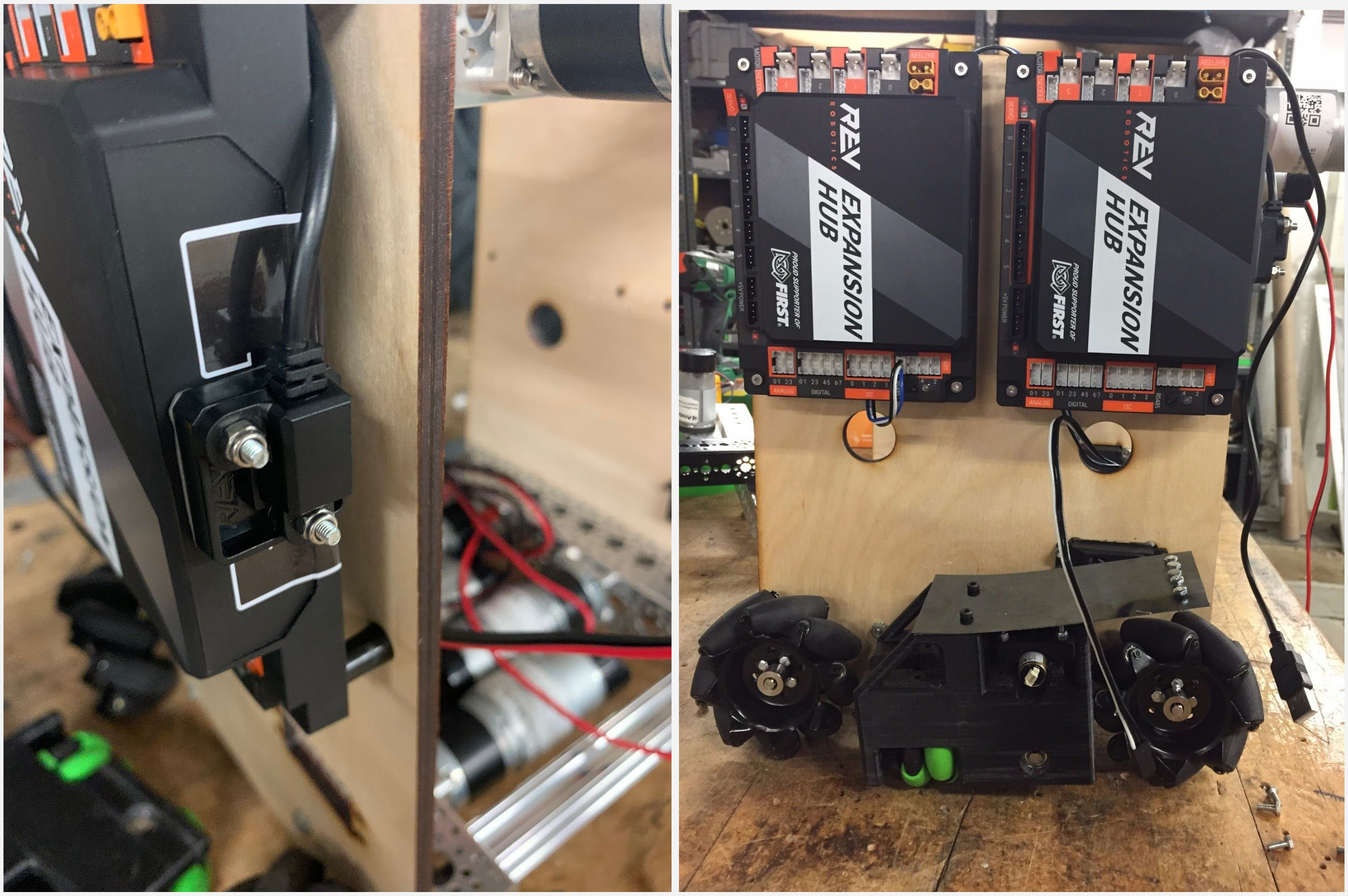


After our extra meeting yesterday, Patrick and Bryan worked with Zach and Arnav to attach the side panels and odometry pods to the chassis. This chassis will be given to the programmers ASAP so that they can start localization work. The side panels are made out of wood, to allow for quick editing. Once we're done editing the side panel, the holes will be put into CAD and machined onto metal. Also, a 9 inch cross member was put in to make the walls more rigid and to all for us to mount the motors.

We manufactured standoffs by press fitting nuts into a spacer. This also acted as a screw coupler as there was no screws long enough to mount the REV Expansion Hub. Finally, we are using REV's phone plug mount, so we don't get connection issues.







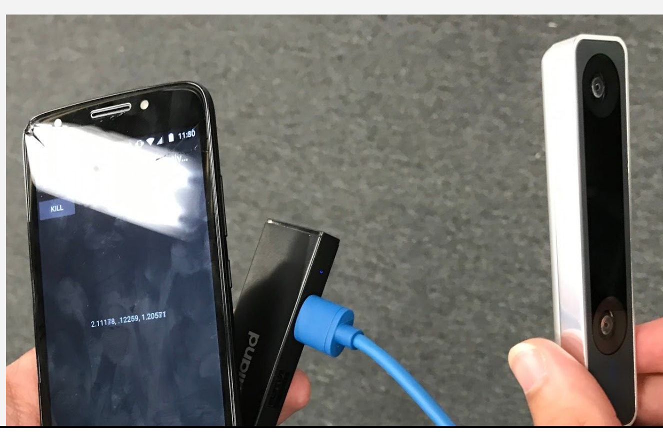
They also worked with Andrew to place in the electronics and REV hubs.

PROGRAMMING ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

INTEL REALSENSE T265

TEST A PROTOTYPE: CAMERA AND POSITION



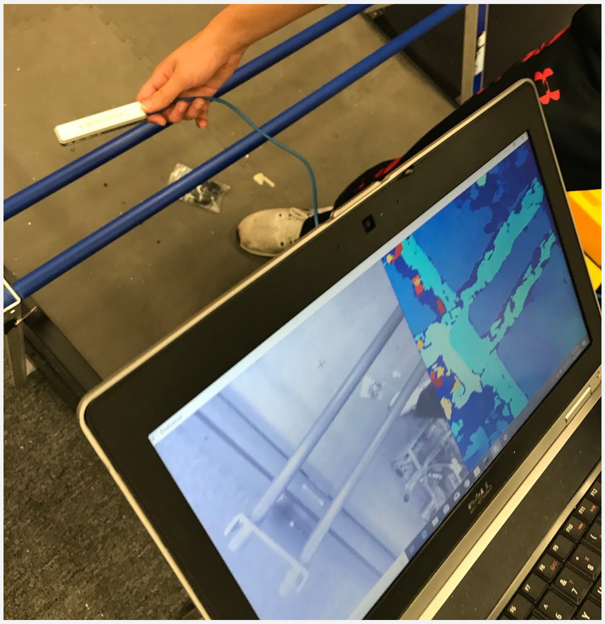
We received new cameras for this season, both of which are Intel RealSense T265. After running the Intel program that provides the live position of the camera, we determined that the location feature on the Intel RealSense T265 cameras is very accurate. Rohan found code in Java that converts data collected from the camera to (x, y, z) coordinates that can be used to determine the camera's location in relation to an initial starting point.

As shown in the image on the left, a coordinate system with values (x, y, z) is displayed on the connected phone by the camera in relation to the initial starting position.

We determined that the use of Intel RealSense T265 cameras can act as a backup to odometry while also providing us with other normal camera functions because of its high accuracy.

To test the accuracy of the camera, Karthik and Rohan walked around the game field with the new camera to analyze the Intel program's ability to track location. Since the camera and program utilize IMU (inertial measurement unit), we are able to track the camera's position on the field and distance travelled relative to the starting location.

TEST A PROTOTYPE: DEPTH PERCEPTION



After more investigation into this camera's functions, we discovered that the camera can produce several different images. In the picture to the right, two different images are presented on the laptop. The image on the left shows an exact representation of the picture in grayscale while the image on the right shows depth perception where red and light blue colored objects show that an object is closer to the camera. Although the depth perception is useful for robot movement, we decided that a color image is needed over the grayscale image to detect the foundation.

Due to the need for color images, we will need to test the accuracy and potential advantages of having two normal web cameras over the two Intel RealSense T265 cameras.

Karthik continued to try to download image data processing apps onto the phones used for the robot in order for the robot to be able to use Intel RealSense T265 camera data.

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

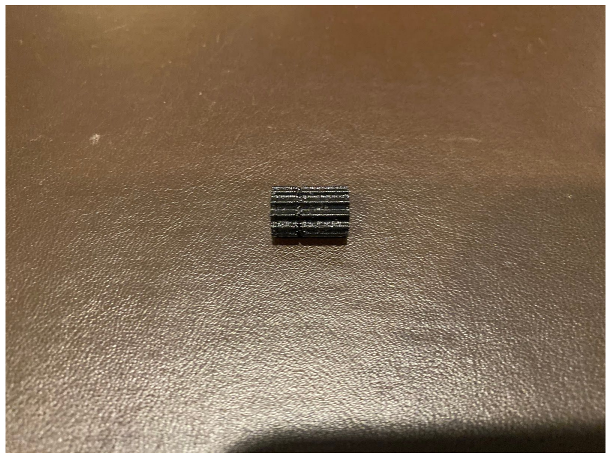
WEB CAMERAS

CONSTRUCT A PROTOTYPE: CAMERA DATA

After working with the two Intel RealSense T265 cameras, Rohan decided to set up two web cameras without the depth perception and IMU present in the Intel RealSense T265 cameras because the web cameras can produce images that are in color. Rohan worked on establishing the camera's ability to receive data regarding color.

3D PRINTING

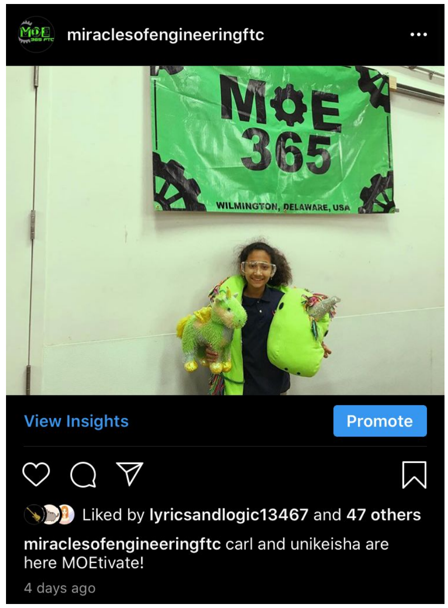
- Ian printed the 12 teeth G2 Pulleys for the wheels of the robot
  - While he was printing the pulley the same issue happened while the 3D printer was printing a model, it was under extruding at times and creating gaps in the print but the rest of the print prints really well.

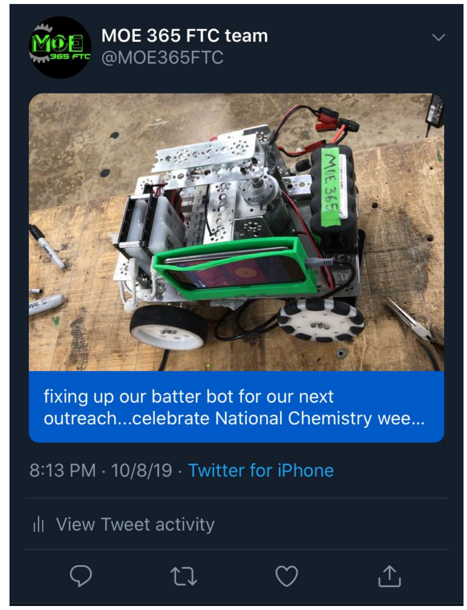


NON-TECHNICAL DISCUSSION

- The registered domain for the MOE website is having trouble connecting to the Squarespace website that Helen and Clare had published earlier this week. We have reached out to the Squarespace support team. We hope to reach a conclusion to this issue soon and have the website running by next week.

- After reviving all three MOE FTC social media accounts (Facebook, Twitter, and Instagram), Helen is working on making MOE FTC more present and reach out to other teams, students, and mentors through social media. Some of this week's posts are shown below:





MEETING SUMMARY

- Claw Prototyping & CAD
- Chassis Superstructure & Electronics
- Intel RealSense Camera Testing

TUESDAY, OCTOBER 15, 2019 MEETING

DATE & TIME: 10/15/19 | 6:00 PM - 8:30 PM

STUDENTS: Connor, Aidan, Clare, Ian, Patrick, Bryan, Kartik, Jonas

MENTORS: Mr. Prettyman

AGENDA
Review team member slides
Teamsnap reminder - please update availability
Timeline update - odometry schedule
Outreach on November 2 - Chemistry Week at the Independence School

TIMELINE REVIEW

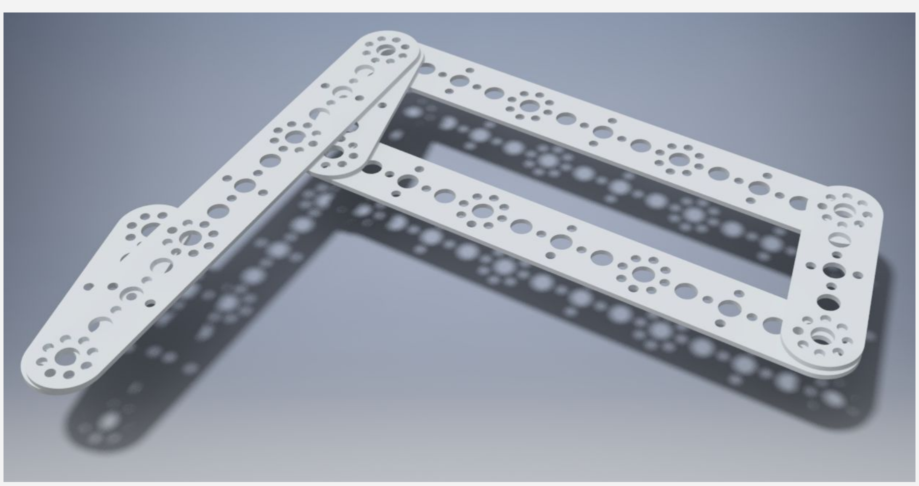
Odometry	Finished by Saturday, 10/19
Programming	Begin odometry pathfinding on Saturday 10/19
Prototyping	Finish prototypes on Saturday, 10/19

MECHANICAL ACCOMPLISHMENTS

Define Problem	Generate Concepts	**Develop a Solution**	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

SCORING STONES

DEVELOP A SOLUTION: EXTENSION CAD



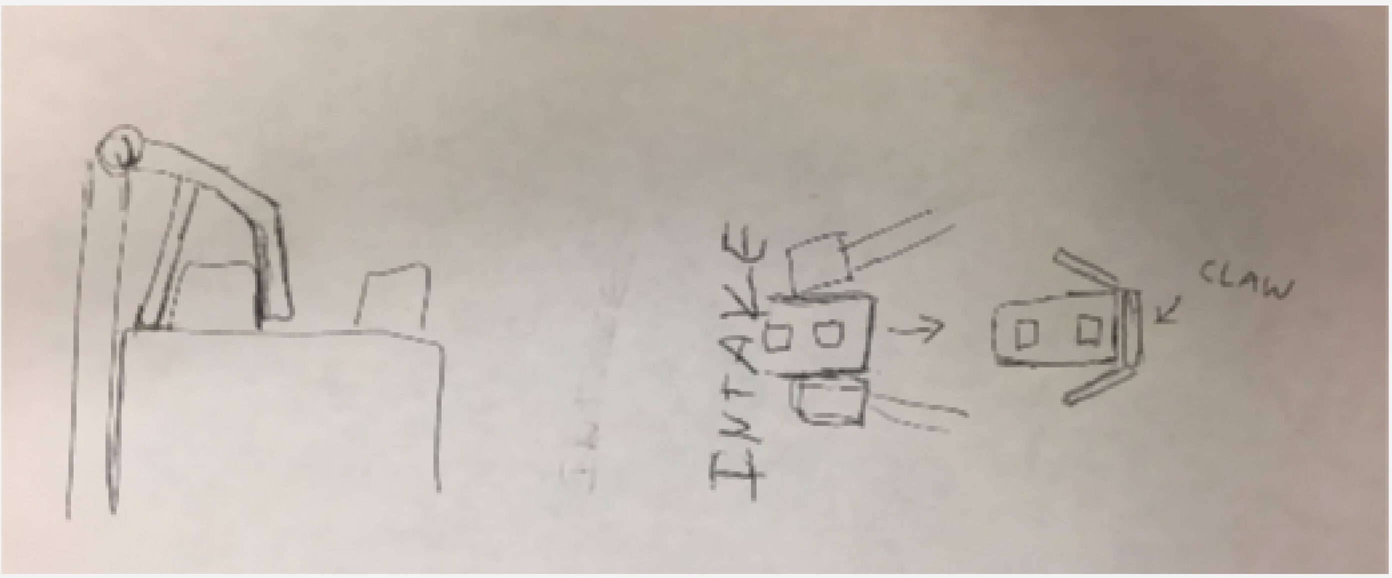
Connor CADed a flat version of the four bar mechanism. However, we cannot actually build this prototype because we don't have the long flat Tetrix beams.

CONSTRUCT AND TEST A PROTOTYPE: NEW CLAW DESIGN

Patrick, Bryan, and Andrew helped Jonas evaluate his design from last meeting. While the part we have functions well, we would still need to implement a second part of the claw that would run perpendicular to the current design in order to be able to place a stones side by side, or adjacent to an existing stone.

This need for a second set of claw arms means that the design will quickly become very complicated. This means that it may make sense to prototype a simpler option.

An idea that Bryan and Patrick had was to have a simpler claw design (below on left).



The stone would align with the help of fixed guide rails and hit the back, flat surface of the claw. Then, a servo would drop and two points would hit the Stone - one on the far side of the stud and one pressing down on the flat, near side of the Stone.

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	**Fabricate and Integrate**	Tweak & Evaluate

ODOMETRY PODS

FABRICATE AND INTEGRATE: ODOMETRY PODS

The deadline for odometry is this Saturday. Our progress for this meeting is mostly delayed because Bryan is not trained in being able to drill through spring steel, so we need to wait until Saturday when there are mentors who are licensed to do so.

NON-TECHNICAL DISCUSSION

- **Patrick and Clare reached out to #15145, RoboRoyals.**

This fellow FTC team is located in Australia and is transitioning from FLL to FTC. We first found out about them through a Reddit post and today we emailed them to offer any help that we could. We are trying to expand our outreach program outside of our local region, so this is a good first step to take and a great opportunity to help another team.

More information about this outreach can be found on **E17**

MEETING SUMMARY

- Claw Designing

SATURDAY, OCTOBER 19, 2019 MEETING

DATE & TIME: 10/19/19 | 9:00 AM - 2:30 PM

STUDENTS: Rohan, Karthik, Jonas, Ian, Helen, Marcus, Clare, Suraj, Isha

MENTORS: Mr. Prettyman, Arnav, Zach, Andrew

AGENDA
Progress update
Finish driving chassis and start drive testing
Finish grabber prototypes

TIMELINE REVIEW

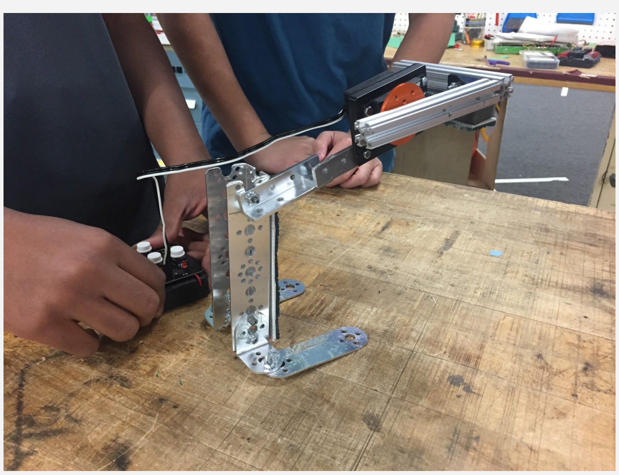
Odometry	Finished today
Prototyping	Basic claw designs finished today
Programming	Start working with chassis today

MECHANICAL ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

SCORING STONES

CONSTRUCT AND TEST A PROTOTYPE: CLAW DESIGNS

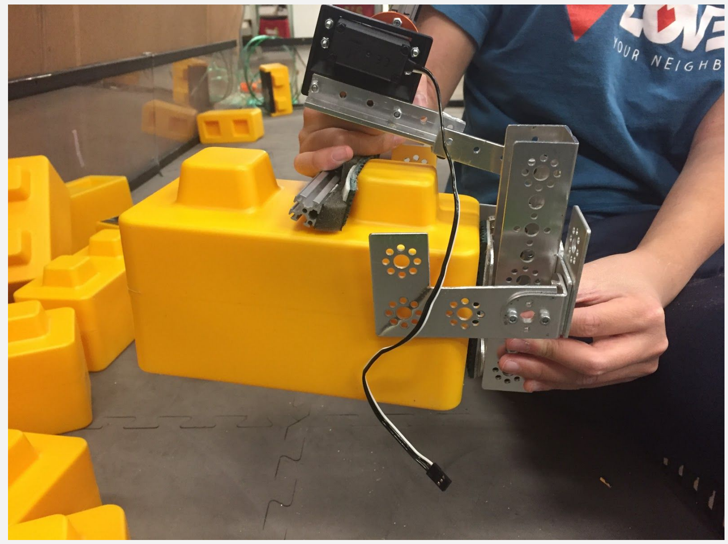


Jonas, Suraj, and Marcus prototyped designs for the claw that would pick up and transport the Stones.

One of the versions we made was a continuation from last week. The design has a flat rubber wall, one claw arm that extends over the Stone's first stud, and a thin base that supports the Stone from underneath. This allows the Stone to be held from the bottom and kept in place by a rubber coated claw mechanism.

One of the issues we faced when building this design was the base underneath. On the first attempt, we accidentally placed the thin base so that it was covering the holes in the bottom of the Stone. This made it impossible for the Stone to interlock with the one underneath when stacking, so we had to alter it to run along the outside of the Stone instead.

Once the design was built, Jonas learned how to use the servo programmer to be able to test it.



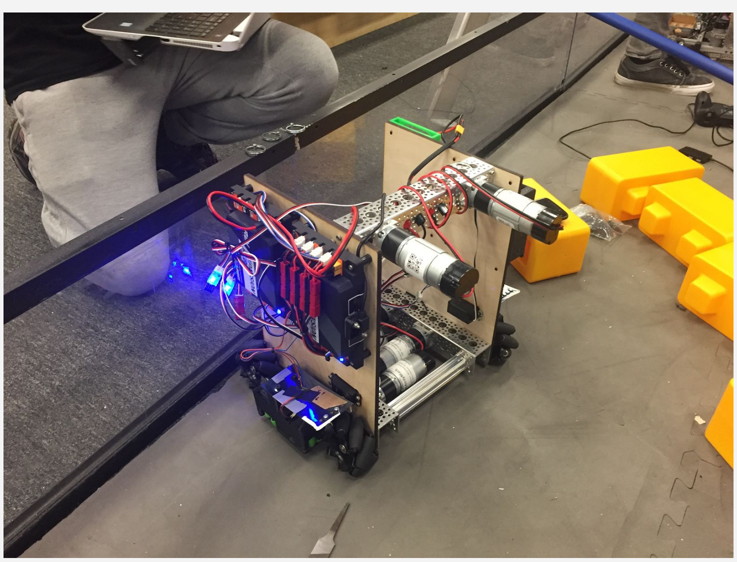
The second design that we worked on was a simpler concept. We wanted to grab the Stone using two claw arms that held the Stone from either side so that the Stone was positioned vertically.

Overall, we are nearing an important decision point where we will have to decide which design we want to focus on to build onto our competition chassis. Of course, we would still be able to backtrack and choose another design if the first one doesn't work as expected, but we still want to invest a lot of thought in evaluating our prototypes. In other words, taking time now to weigh our options will allow us the construction of the final design to be a smoother, easier process.

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	**Fabricate and Integrate**	Tweak & Evaluate

CHASSIS

FABRICATE AND INTEGRATE: BUILDING CHASSIS



Our deadline was to finish the essentials of the chassis and turn it over to the programmers by the end of the meeting. After some final touches on the chassis, the programmers were able to receive the chassis before the end of the meeting and begin simple testing regarding the servos and odometry pods.

Sadly, towards the end of the meeting, one of the pulleys of the drivetrain broke. We plan to reprint this to get a working chassis later

Define Problem	**Generate Concepts**	Develop a Solution	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

BATTERY HOLDER

DEFINE PROBLEM: BATTERY HOLDER

Zach and Arnav need a Battery holder that would be mount on one of the side panels of the robot. So, they tasked Ian to CAD a battery holder that would be able to mount by aligning with the screw holder in the side panels

GENERATE CONCEPTS: BATTERY HOLDER

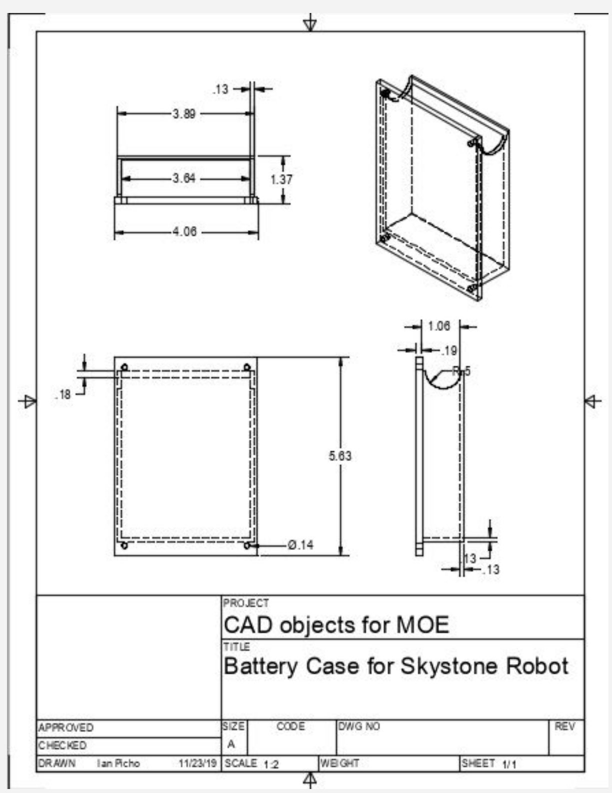
Ian started by gathering the measurement he needed to make the battery holder using calipers. The measurements are:

- Robot Battery
    - Length: 4.46 in
    - Width: 3.516in
    - Height/Depth: 0.930 in
        - For these measurement, he added ⅛ to each measurement to allow for room when we put the battery in and for the model shrinking a little bit when 3D printed.

- Also, Zach and Arnav said that the walls of the hold should be an ⅛ of an inch thick and base should be and ⅛ of an inch

Ian then CADed the battery holder

- I started by make the baseplate of the battery holder by copying the dimensions of the baseplate from the control hub because it had the holes for mounting in the right place.
    - He made the baseplate of the battery holder as ⅛ inches.
- Then, I made the actual battery holder with the demensions I measured for the battery with the increase of ⅛ inches. The walls of the battery case is ⅛ inch
    - Then, I cut out a semicircle near the open of the battery case in the short lengths of the battery. This is so that it is easier to grab the batteries when you want to take them out.



Define Problem	**Generate Concepts**	Develop a Solution	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

PHONE CASE

DEFINE PROBLEM: PHONE MOUNT

Zach and Arnav need a Phone Case that would be mount on one of the side panels of the robot and also held an external battery for the phone.
So, they tasked Ian to CAD a battery holder that would be able to mount by aligning with the screw holder in the side panels

GENERATE CONCEPTS: PHONE CASE SPECIFICATIONS

Ian started by gathering the measurement he needed to make the phone case using calipers. The measurements are:

- Phone Dimensions
  - Length:
  - Width:
  - Height/Depth:
    - For these measurement, he added ⅛ to each measurement to allow for room when we put the battery in and for the model shrinking a little bit when 3D printed.

- Also, Zach and Arnav said that the walls of the hold should be an ⅛ of an inch thick and base should be and ⅛ of an inch

Ian then CADed the battery holder

- I started by make the baseplate of the phone case by copying the dimensions of the baseplate from the control hub because it had the holes for mounting in the right place.
  - He made the baseplate of the battery holder as ⅛ inches.

PROGRAMMING ACCOMPLISHMENTS

Define Problem	**Generate Concepts**	Develop a Solution	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

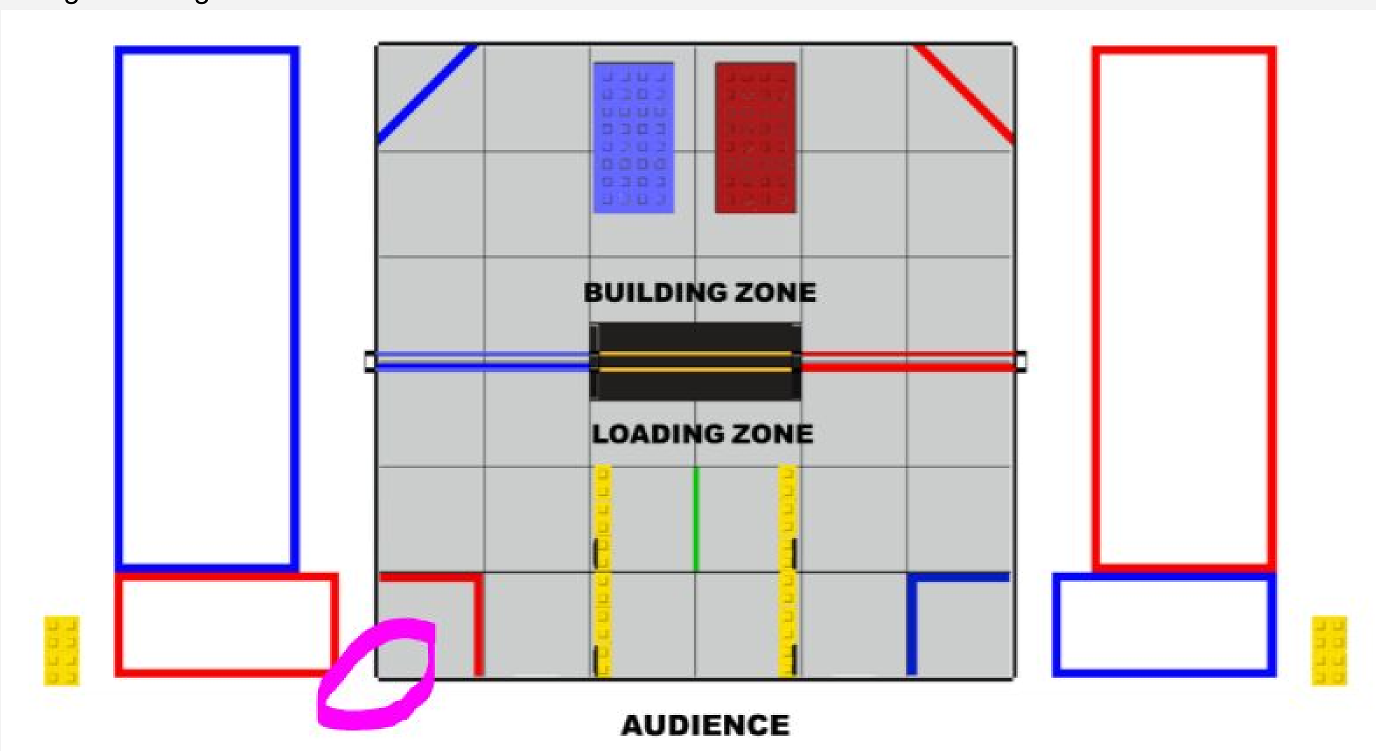
ODOMETRY ALTERNATIVE

GENERATE CONCEPTS: C++ AND CAMERA

Last week, we received two Intel RealSense T265 cameras for our chassis. Overall, the benefits of these cameras are manifold. We looked into existing C++ libraries and code for these cameras and are investigating the feasibility of translating this code to Java in order to combine odometry and camera vision in the robot. As discussed in the Saturday, October 12, 2019 notebook entry, the Intel RealSense T265 cameras can replace odometry on our chassis but require separate programs for them to be implemented into the existing code for our robot.

GENERATE CONCEPTS: FIELD COORDINATE SYSTEM

In a brief decision-making period, we identified the need for a coordinate system that matched the game field in order for odometry and location of the robot to be easily identified. To make the coordinate system easy to use, we decided that the corner of the field with the red depot is (0,0). This is marked by the purple circle in the image above. With a set coordinate system, it becomes easy to name the location of the robot throughout the game.

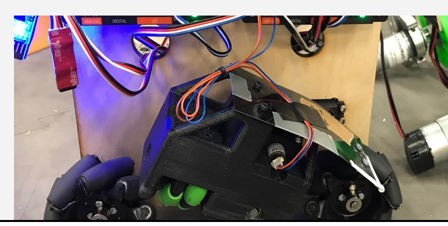


Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

ODOMETRY TESTING

TEST A PROTOTYPE: SERVOS AND ODOMETRY PODS

During the autonomous period, the two odometry pods on the sides of the robot will be lowered in order to track the location of the robot throughout autonomous. However, these pods will have to be raised during the teleop period so they will not interfere with any stone



harvesting or skyscraper construction. While working with Arnav, Rohan and Karthik edited the code for the servos that are connected to the two odometry pods in order to raise or lower the pods.
One problem that arose during this testing is the odometry pods raising to different levels. While the left odometry pod rose higher than expected, the right odometry pod did not rise as high as needed. After examining and reconnecting some wiring, both odometry pods were able to rise as programmed but overshot and still rose higher than we had anticipated. Rohan decided to manipulate the range of values that the servos can rotate to so the odometry wheels will rise to the desired height. By changing this range, both odometry wheels are raised at a good height to avoid contact with the mecanum wheels.

After testing the odometry pod raising mechanism, we added some weight onto the chassis to see if the chassis will be able to go over the raised platform below the center skybridge. The chassis was successful in this attempt.

NON–TECHNICAL DISCUSSION

- **The chassis should be turned over to the programmers by the end of this meeting.**

This means that all wiring, odometry pods, and batteries need to be finalized.

- **Helen and Clare uploaded the Engineering Notebook from last year onto our team website.**

Since the file was too large to upload as one PDF, we included separate links to each section of the notebook. However, the Engineering Section was still too large, so we had to split it into two parts.

We have not heard back from SquareSpace regarding connecting the MOE domain to the website. A temporary SquareSpace domain has been placed on the website that Clare and Helen made so we can make our information available now.

- **We received a reply from team #15145 RoboRoyals (*Now #12993 RoboKings)**

After emailing them on Tuesday, we were happy to hear back from them. They were mostly looking for advice regarding programming, as their programmers are not very experienced and have not used Android Studio before. Karthik, Rohan, and Helen replied back with suggestions for their programming team.

More information about this outreach can be found on **E17**

- **We updated the Battery Board.**

Our battery board is one of our team's proudest creations! Unfortunately, it was also in need of some repairs and upgrades. Arnav and Zach helped us to attach a new power strip, adjust the positions of the chargers, and add new spots for our phones and battery packs. Then, we got all of our batteries charged and ready for the programmers to use with the chassis.

MEETING SUMMARY

- Continue Prototyping Mount
- Battery Mount Print/Phone Mount CAD
- Exploring Odometry Alternatives
- Odometry Servo Testing

TUESDAY, OCTOBER 22, 2019 MEETING

DATE & TIME: 10/22/19 | 6:00 PM - 8:30 PM

STUDENTS: Rohan, Isha, Patrick, Bryan, Paige, Clare, Helen, Connor, Ian, Suraj, Aidan

MENTORS: Mr. Prettyman

AGENDA
Review team member slides
Subteam plans and updates
Timeline goals

TIMELINE REVIEW

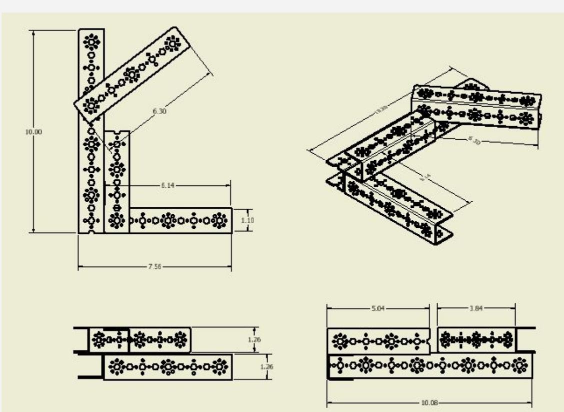
Programming	Finish initial chassis tests by Tuesday, 10/29
CAD	Harvester, lift, and claw done by Tuesday, 10/29

MECHANICAL ACCOMPLISHMENTS

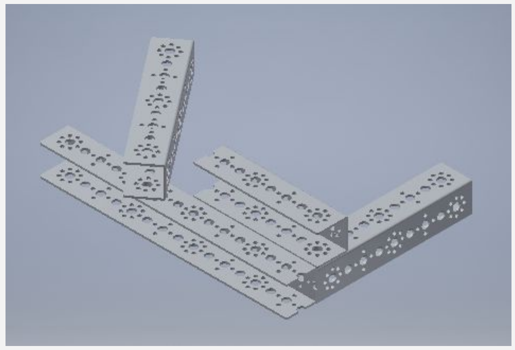
Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

SCORING STONES

DEVELOP A SOLUTION: PROTOTYPE GRABBER CAD



Isha was CADing one of the prototypes that Clare, Suraj, and Jonas were working on. She finished CADing the prototype, and started to make the diagram. She showed the measurements each part in the diagram, explaining the CAD model. She had to decide where to connect each part together, and which parts to measure. Isha had a problem with which pieces to constrain in the beginning, but learned which parts to constrain. Isha plans to start and finish CADing other prototypes for the grabber.

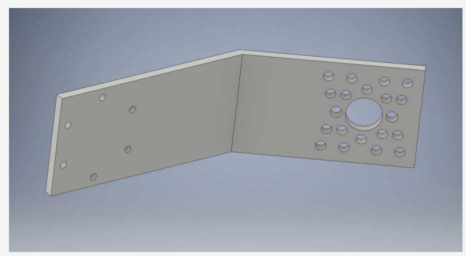


Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

DELIVERING STONES

CONSTRUCT & TEST A PROTOTYPE: HARVESTER MOUNT

Our intake mechanisms needs to be mounted on an angle in order to pick up Stones into the robot. We CADed this mounting bracket with an actobotics hole pattern.



Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

BATTERY HOLDER

CONSTRUCT A PROTOTYPE: BATTERY HOLDER

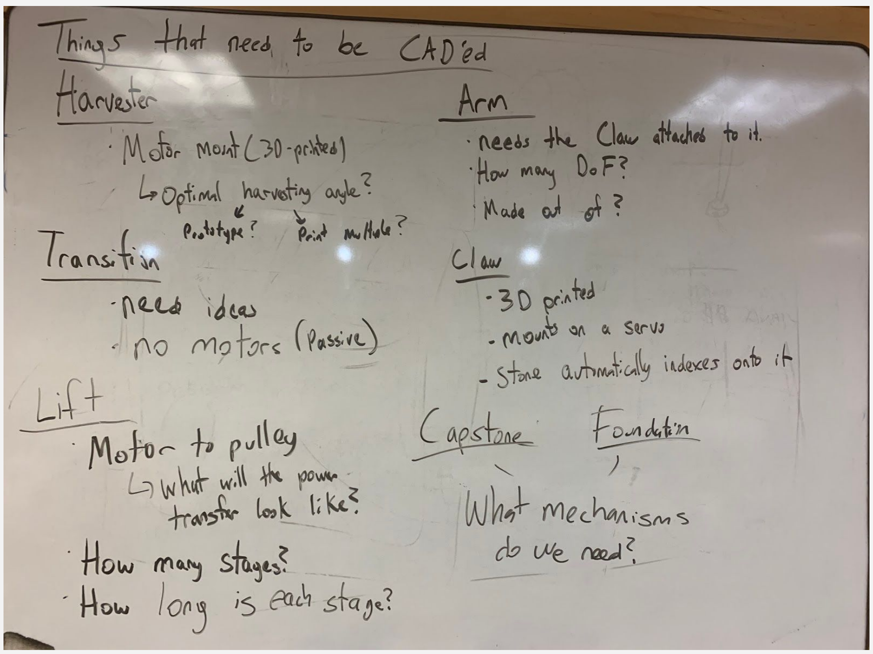
- After finishing the CAD model of the battery holder on Saturday the 19th, Ian made the Cad model into an .stl file and put it into the PrusaSlicer Slicer software
- The Settings for the battery holder
  - 0.3 mm layer height
  - 30% infill
  - Grid Infill
  - Supports on
- Then, I made the battery holder object in the slicer into a .gcode file. A .gcode while is a file of coordinates for the printer to use to print each layer of the model.
- After that, I preheated the hotend to 260°C and the print bed to 60°C

- After that, I cleaned the nozzle of the printer and the printer calibrated itself
- After that, the 3D printer started to print the battery holder.

Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

CAD PLANNING

DEVELOP A SOLUTION: DELEGATING CAD



In order to get CAD designs rolling out, Bryan created a list of the main mechanisms we wanted to CAD, and created a list of all unknowns associated with CADing the given mechanisms. This way, he had a better understanding of the difficulties of CADing each mechanism. He saw that the Harvester be assigned to Connor as the prototype was finished and it was the least dependent on the actual chassis. He could complete it without the chassis or CAD of the chassis, so it was ideal. Bryan gave himself the lift because I had the CAD of the chassis. Jonas has been working on the the claw/gripper, so he was assigned to CAD his idea of a final design.

PROGRAMMING ACCOMPLISHMENTS

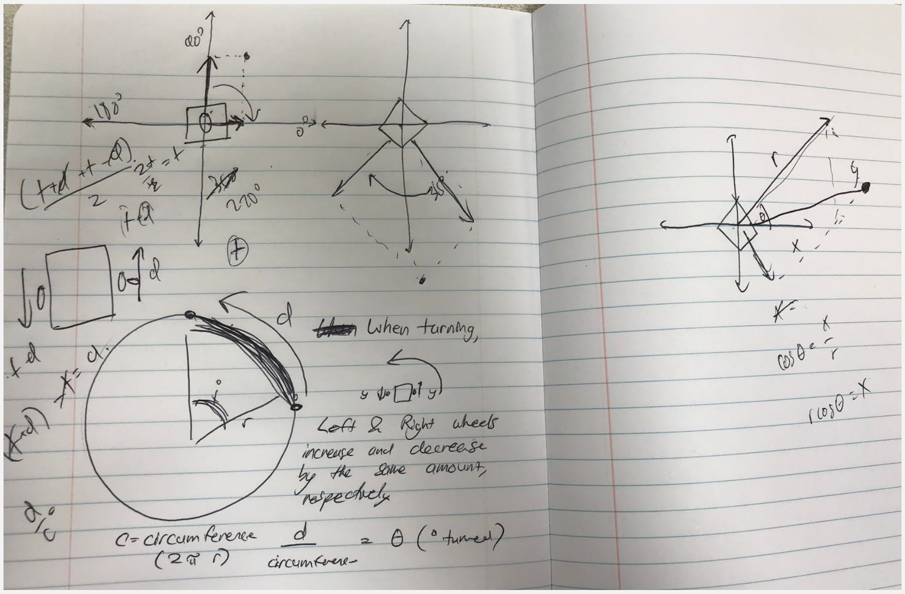
Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

ODOMETRY

DEVELOP A SOLUTION: ODOMETRY PROGRAMS

In order to determine the location of the robot throughout the game (specifically during the autonomous period), we decided to implement a program that takes the distance travelled recorded by the odometry wheel and the angle of the robot. The code then calculates the location using a series of vectors, as shown in the diagrams below.

There will be three odometry wheels on the robot, two of which are facing forward and one facing sideways. When the robot travels in a diagonal direction, the forwards-facing odometry wheels will travel a specific distance in the y-axis direction while the sideways distance will travel a separate specific distance in the x-axis direction. By setting up a system of vectors (shown on the right page diagram of the above image), we are able to use the Pythagorean theorem to calculate the total diagonal distance travelled and also determine the new x and y coordinates of the robot.



To ensure that the odometry wheels do not pick up turning or rotations as distance moved by the robot, the second forward-facing odometry wheel can be utilized. When the robot turns, one forward-facing odometry wheel will register forward movement while the other forward-facing odometry wheel will register backwards movement. For example, if the robot was turning right, the forward-facing odometry wheel on the right side of the robot will pick up backwards motion while the forward-facing odometry wheel on the left side of the robot will pick up forwards motion. Although the motion that is registered by the two wheels have different directions, the magnitude of the motion is the same on both wheels. Through calculations, the forwards and backwards movements cancel each other out, and the odometry program disregards this turning movement.

Ultimately, these new odometry programs are crucial to determine the robot's position. This is helpful during the autonomous period, as the robot's location can guide its movement on the field.

NON-TECHNICAL DISCUSSION

- **Clare began writing the Team Plan.**

We want to get an early start with writing the Team Plan so that we can continue to add to it throughout the season. I looked at our Business Plan from last year and examples from other teams, and began writing the SWOT analysis, finances, and sustainability sections.

- **Mr. Prettyman scheduled some of the Delaware meet dates.**
- **The programming team is planning on integrating GitHub into their process.**

This will allow for all programs to be stored in a central, organized location with universal access by all team members.

- **Helen and Clare edited the website.**

Information and links to the website were published on the MOE social media accounts to interact with members of the community.

MEETING SUMMARY

- Odometry Programming

- Prototype Grabber CAD
- CAD Planning

SATURDAY, OCTOBER 26, 2019 MEETING

DATE & TIME: 10/26/19 | 9:00 AM - 2:00 PM

STUDENTS: Ian, Karthik, Katy, Paige, Helen, Jonas, Connor, Aidan, Clare, Rohan, Isha, Suraj

MENTORS: Mr. Prettyman

AGENDA
Assess timeline goals
Many team members present - assign tasks
Discuss possibility of Newark Charter outreach

TIMELINE REVIEW

CAD	Harvester, claw, and lift CAD finished by Tuesday, 10/29
Programming	Finish initial chassis tests by Tuesday, 10/29

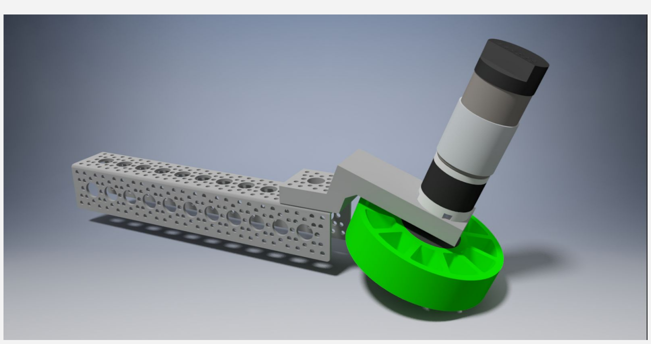
MECHANICAL ACCOMPLISHMENTS

Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

DELIVERING STONES

DEVELOP A SOLUTION: INTAKE CAD

The CAD for the harvester has a deadline of this Tuesday, so Connor made this a priority.



Connor continued the CAD of the intake mechanism. The angle, thickness, and length of the part can easily be modified if they have to. The ActoBotics piece in the picture is the ActoBotics piece on the robot.

While we did test to find the optimal angle of harvesting last week, we are leaving plenty of opportunity for adjustment once we attach this to the robot.

Define Problem	**Generate Concepts**	Develop a Solution	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

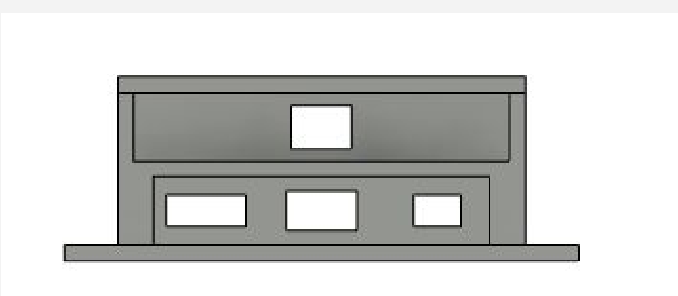
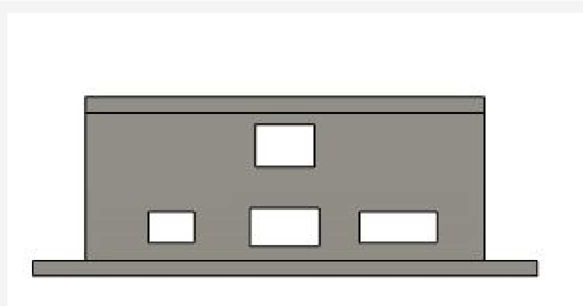
PHONE CASE

GENERATE CONCEPTS: PHONE CASE

Ian continued working on the CAD on the phone case

- He CADed the holder for the external battery for the phone
    - he first sketched out the rectangle with dimensions of the phone with the walls around it. This is so that the platform of the external battery is big enough to place the phone holder.
    - Then, he made a rectangle in the top center of the rectangle of the phone.
    - After that, he extruded the walls around the external battery rectangle
- Then, he added a ⅛ inch wall on top of the external battery holder to separate it from the phone case.
- After that, he made the phone holder with the dimensions I measured for the phone we are using with the increase of ⅛ inches in each dimension. The walls of the battery case are ⅛ inch
    - he put in a slot for the micro USB charger port and for the power button and volume buttons
    - he added curved pieces above the phone case to hold the phone in.
- After that, he added holes in the wall of the external battery compartment of the photo case holder near the phone's usb cable hole. He added hole for the power bottom, the USB cable and the micro usb cable.

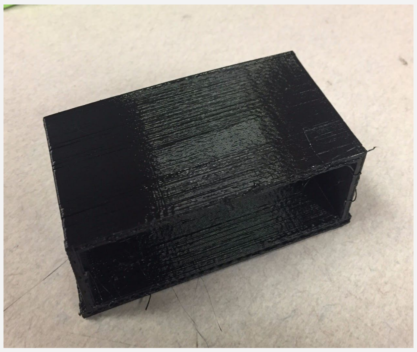


Define Problem	**Generate Concepts**	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

BATTERY HOLDER

CONSTRUCT & TEST A PROTOTYPE: BATTERY HOLDER



The battery holder that Ian print on Tuesday, October 22 meeting fail. The print when I found it was off the print bed and on the print bed was a spaghetti of filament that the printer printed.

- The cause of the print to fail is that Ian printed the object where the piece of it had been stuck to the bed had a small surface area. Then, while the 3D printer was printing the battery holder, the sides of the print that was stuck to the bed warped, of curved up and the extrude hit the print off. Then, It printing into space after knocking off the print and then created the spaghetti of filament

After I cleaned off the print, Ian printed the battery holder again but this time insure it does not fail.

- I started by using a slicer program to make the battery holder cad file in a file the printer can use to print the object and for the user to put specs of the print. Ian oriented the battery holder so that the print sticks to the bed on a large surface area. The specs of the print Ian put for the print are:
    - Layer height: 0.30 mm
    - parameter/wall: 3 parameters
    - Infill: 20% infill
    - Supports: On
- Then, Ian made the battery into a .gcode file and heat the printer extruder and print bed to the right temperature.
- Then, the printer calibrated itself and started to print the battery holder.
- Ian watched the first layer print and it printed out well.

PROGRAMMING ACCOMPLISHMENTS

Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

VERSION CONTROL

DEVELOP A SOLUTION: GITHUB

In previous years, the programming team faced complications regarding finding old code and ensuring that all members of the team had access to the right/most up-to-date code. To overcome this problem and be more organized in maintaining different versions of the code, Karthik decided to utilize GitHub. GitHub is a software development platform that organizes code and allows users to access previous versions of the code, similar to versions of a document in Google Docs. In the same way as Google docs, GitHub allows multiple users to manipulate code and see what changes have been made with other users. For MOE, GitHub would help the programming team maintain code for multiple robots and multiple versions of code in an organized fashion.

NON-TECHNICAL DISCUSSION

- **The moeftc.org domain is now connected to the MOE website.**

After talking to SquareSpace customer service, Helen resolved the problem of the domain issues with the website, which can now be accessed through the moeftc.org and moe365ftc.squarespace.com domains.

- **Team members from NCS discussed the possibility of an outreach.**

In order to spread FTC and robotics to the surrounding community and account for the lack of robotics in the area, we want to create a new FTC team involving Newark Charter School students.

MEETING SUMMARY

- Intake CAD
- Phone & Battery Holder

TUESDAY, OCTOBER 29, 2019 MEETING

DATE & TIME: 10/29/19 | 6:00 PM - 8:30 PM

STUDENTS: Patrick, Bryan, Rohan, Clare, Helen, Ian, Karthik, Jonas

MENTORS: Mr. Prettyman, Nick

AGENDA
Review team slides
Mr. Prettyman - CAD organization
Review chassis/lift CAD
Timeline for CAD/build subteam

TIMELINE REVIEW

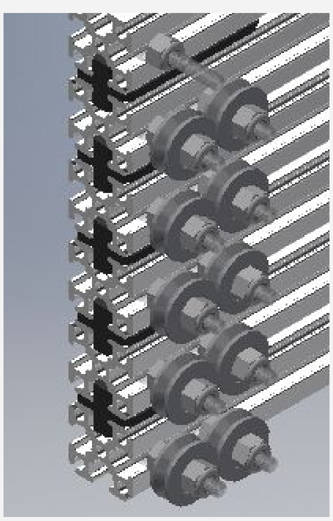
CAD	lift/chassis are done, harvester/claw are due Saturday

MECHANICAL ACCOMPLISHMENTS

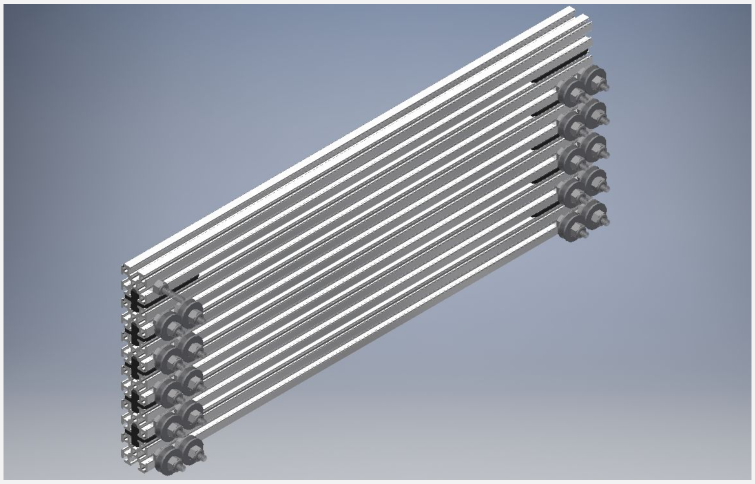
Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

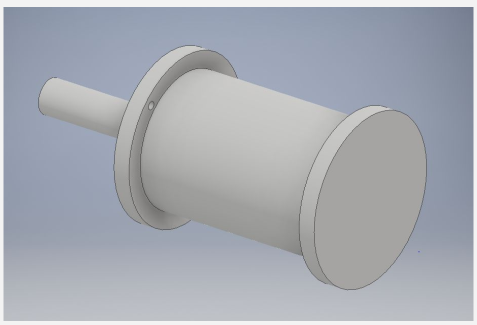
STACKING STONES

DEVELOP A SOLUTION: LIFT CAD

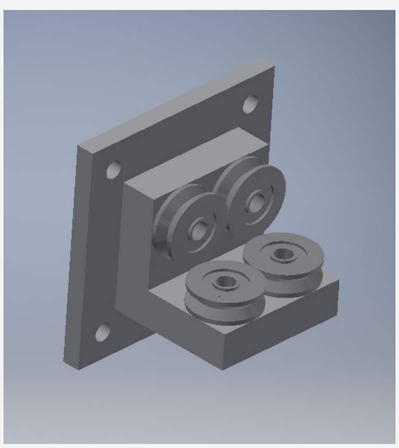


The lift CAD was fairly straightforward. Bryan used to REV Linear Slide kit in his CAD. He made each stage 10 inches long, as that is our maximum length due to height restraints. Because of this, each stage gave us around 7.4 inches of extension (measured by the inside length between two REV sliders). He decided to use another pulley to act as a pulley guard, which is a good option as a low friction pulley guard. This was inspired by cable machines at gyms. The idea will be used again in the pulley bracket for this system.





Then, he CADed a spool with an outer diameter of 1.5 inches. This measurement was chosen so that the spool would be flush with the top of the top cross member. It is 2 inches long to create ample space to house the string, and a hole was created in the walls to tie the string to. The spool has an 8mm shaft, allowing us to use our 8mm bearings, and an 8mm to 6mm shaft coupler to mount it to an Andymark Motor.



Finally, he designed a bracket that served three purposes. The first purpose is to funnel the string coming from the spool. This is needed because the spot at which the string comes out of the spool is unpredictable. The two tangent pulleys creates a low-friction funnel and prevents the string from escaping. The second function is to rotate the direction that the spring is spooling to be the same direction to be able to pull the linear slides. The third function is to keep the string in line with the pulleys on the linear slide.

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

BATTERY HOLDER

CONSTRUCT & TEST A PROTOTYPE: BATTERY HOLDER

The battery holder that Ian print on Saturday, October 26 meeting failed. The print was stuck to the bed nicely and printed well. The problem was that the support material did not stick to the print well and the extruder caught onto the support material and was ripping it out and my teammates saw it and stopped the print.

After I cleaned off the print, Ian printed the battery holder again but this time insure it does not fail.

- I started by using a slicer program to make the battery holder cad file in a file the printer can use to print the object and for the user to put specs of the print. Ian changed the orientation of how the support material would print, decreased the support material print speed and increased the line thickness of the support material. The specs of the print Ian put for the print are:
  - Layer height: 0.30 mm
  - parameter/wall: 3 parameters
  - Infill: 20% infill
  - Supports: On
- Then, Ian made the battery into a .gcode file and heat the printer extruder and print bed to the right temperature.
- Then, the printer calibrated itself and started to print the battery holder.
- Ian watched the first layer print and it printed out well.
- While the print was printing, Ian noticed that the spool of filament was almost out of filament but because a filament sensor was added in the recent upgrade, when the filament would run out, the printer would stop and wait for a new filament to be put in.
- Then, Ian tested if the filament sensor to see if it works and stops the print when the filament is out and it works.

PROGRAMMING ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

ODOMETRY

CONSTRUCT & TEST A PROTOTYPE: ODOMETRY

Over the past week, we were unable to finish testing odometry due to issues with the chassis. While the mechanical team did get the chassis to drive, some of the pulleys in the robot broke in the middle of weight tests. In an attempt to test odometry without a driving chassis to save time, the programming team tried to turn the wheels of the chassis by hand to determine if the odometry program would give us output regarding the distance travelled by the robot.
Using this described method, we were able to determine that the sensors and odometry wheels work through the odometry program as turning the wheels gave us output values.

NON-TECHNICAL DISCUSSION

- **Clare, Helen, and Katy have been working on sponsorships.**

We have several legacy sponsors, but we want to expand our professional connections with new companies and organizations. More information on this can be found in the Team Plan (Section G)

- **Mr. Prettyman arranged for #16378 Kaizen Robotics to meet with us on 11/9.**

This is a local rookie team that is advancing from FLL. We have been contacting them since the summer, but now we have a scheduled date to meet with them at a Saturday meeting. They are interested in help with camera identification and notebook.

- **National Chemistry Week at the Independence School is this Saturday.**

Several team members will leave from the Saturday meeting to attend this annual event. Based on the last few years, we are expecting a steady crowd of mostly elementary school kids, including boy and girl scouts.

- **November 16 is the Oxford Scrimmage.**

We are on the list of attendance but have not received information yet.

- **We need to have a better CAD organization system.**

At the last meeting, we realized that our progress was being slowed by the fact that the CAD on Patrick's laptop was not accessible by Connor, Jonas, or Isha. Similarly, Jonas left his CAD laptop in the lab over the weekend and was not able to work on it. Therefore, we need to implement a cloud-based system.

- **Bryan finished the CAD for the lift.**

Some parts we have, some parts we need to 3D print, and some parts we will need to buy. Bryan will give the CAD to someone else so that they can take an inventory of the parts we will need to get.

- **Helen created a schedule for social media posts.**

During Tuesday meetings, pictures will be taken that will be posted throughout the week (Tuesday to Thursday). On Fridays, a post will be sent out on one of the social media platforms to inform followers about FTC as a whole → will use the hashtag #ftcfriday. The cycle of posts will restart on Saturday (Saturday to Monday) in order for a post to be out everyday of the week. This will help us reach out to spread information about FIRST robotics and connect with other teams.

MEETING SUMMARY

- Sponsorship Letters
- Lift CAD

SATURDAY, NOVEMBER 2, 2019 MEETING

DATE & TIME: 11/02/19 | 9:00 AM - 2:30 PM

STUDENTS: Patrick, Bryan, Ian, Connor, Helen, Paige, Aidan, Karthk, Jonas, Suraj, Rohan, Katy

MENTORS: Mr. Prettyman, Zach, Arnav, Andrew

AGENDA
Outreach at the Independence School for National Chemistry week
Fix the pulleys on the chassis and get it ready for odometry testing

TIMELINE REVIEW

CAD	First Stage Cad for Arm, Transition, Capstone, & Foundation, 11/9
Chassis	Driveable, able to harvest and dispense by 11/16
Programming	Park in autonomous, 11/16

MECHANICAL ACCOMPLISHMENTS

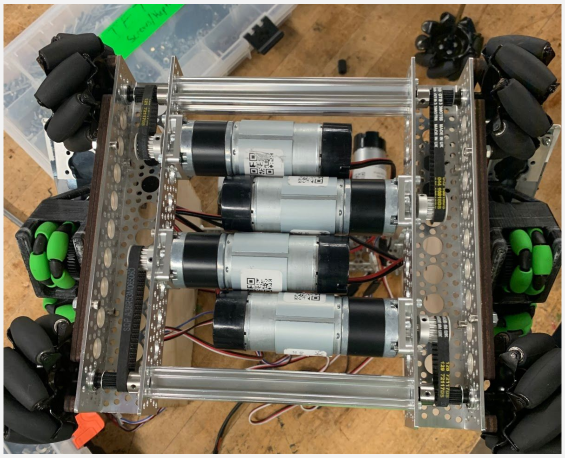
Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	**Fabricate and Integrate**	Tweak & Evaluate

CHASSIS

FABRICATE AND INTEGRATE: FIX DRIVE PULLEYS

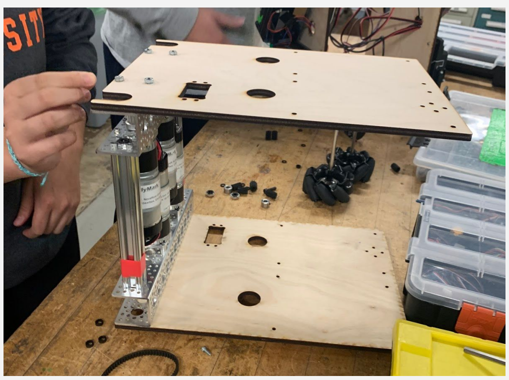
Because our mentor Arnav goes to UD, we outsourced for better 3D printing for our drive pulleys. We would prefer to use the injection mold that REV sells, but it is currently not for sale. Using the new prints, we replaced all the drive pulleys of the competition chassis. We hope these prints withstand more weight than the previous prints because we will have to use them for the upcoming Oxford scrimmage.

FABRICATE AND INTEGRATE: FIX DRIVE PULLEYS



After we remounted all of the pulleys we saw how the odometry wheels fit. There is plenty of room between the wheels for the odometry wheel.

FABRICATE AND INTEGRATE: SECOND CHASSIS SIDE PANELS



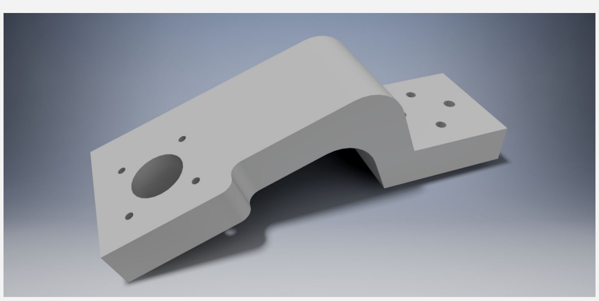
Since we had a lot of members for the meeting, we were able to get some work done on the second chassis. We put on the side panels and wheels to make it have the shape of a complete robot. Because this robot is used for prototype/testing purposes, it will not need electronics right away.

Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

DELIVERING STONES

DEVELOP A SOLUTION: INTAKE CAD

Connor improved the CAD of the intake. He made the custom part thicker and removed some of the unnecessary ActoHoles. He also offsetted the motor holes horizontally, allowing us to adjust the width of the harvester if we need to. He defined many of the important dimensions using parameters so they can be adjusted easily.



Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

BATTERY HOLDER

CONSTRUCT & TEST A PROTOTYPE: BATTERY HOLDER

When Ian checked the print of the battery case, the printer had paused as planned from the spool of filament running out. So, this means that the print can be resume with another filament. The filament that Ian put in was a black carbon fiber petg. He had not used this filament before so he did not know if the filament would print well at the setting he used for the other petg filament.

- While the printer was continuing the battery holder with the carbon fiber petg filament, the extruder was printing the filament pretty well but there was spots where the extruder was under extruding the filament or stopped extruding the filament for a little bit.

PROGRAMMING ACCOMPLISHMENTS

Define Problem	**Generate Concepts**	Develop a Solution	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

PURE PURSUIT

GENERATE CONCEPTS: PURE PURSUIT

Pure pursuit is a method that allows a robot to follow a set of points intelligently. With this method, we would enter a set of points as input to the robot every few centimeters that the robot travels. The robot internalizes these points and travels to them. While the robot is travelling, it corrects itself if there are any issues or deviations off of the designated path created by the set of points.

The programming team is adapting the pure pursuit method from last season's code to match the SkyStone game. Pure pursuit will be used to aid in pathfinding specifically during the autonomous period, in addition to helping the robot with travelling issues. Also, the previous code for pure pursuit will be adapted to fit the Kotlin language for convenience.

To explain the pure pursuit, we looked at papers written on the method including the following:
https://www.ri.cmu.edu/pub_files/pub3/coulter_r_craig_1992_1/coulter_r_craig_1992_1.pdf
https://www.chiefdelphi.com/uploads/default/original/3X/b/e/be0e06de00e07db66f97686505c3f4dde2e332dc.pdf

NON-TECHNICAL DISCUSSION

- **REV Robotics gave us a monetary sponsorship.**

We were able to receive a monetary sponsorship donation to purchase parts for the robot.

- **Clare and Helen sent out more sponsorship requests.**

- **Several of our team members attended National Chemistry Week this afternoon.**

MOE was able to participate in this outreach and expose younger students to the basics of robotics at the Independence School. More information about this outreach can be found on page **E21**

- **Our CAD team worked on organizing CAD drawings.**

In order to ensure each member of the design team has access to each other's CAD designs, the design team is posting their files in the Google Drive.

- **The programmers finished setting up GitHub.**

Karthik was able to connect Rohan to the programming team GitHub so past versions of code and new code can be organized and combined for easy access during future events/competitions.

MEETING SUMMARY

- Drivetrain Fixed
- Pure Pursuit
- Improved Intake CAD

TUESDAY, NOVEMBER 5, 2019 MEETING

DATE & TIME: 11/05/19 | 6:00 PM - 8:30 PM

STUDENTS: Paige, Clare, Helen, Ian, Patrick, Rohan, Karthik, Aidan

MENTORS: Mr. Prettyman, Nick, Andrew

AGENDA
Team member slides
Priority list (3d prints)
Assign National Chemistry Week Outreach entry
Set next stage of deadlines/deliverables

TIMELINE REVIEW

Chassis	Driveable, able to harvest and dispense by 11/16
Programming	Park in autonomous, 11/16

MECHANICAL ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	Fabricate and Integrate	**Tweak & Evaluate**

BATTERY HOLDER

TWEAK & EVALUATE: BATTERY HOLDER CRACKS

- The battery holder printed out pretty well but there was a part of the carbon fiber PETG section of the print where there was a big crack in the filament
    - the battery holder, we can tape or glue the crack to fix it for now because we have a scrimmage and we are pressed with time for 3D printing parts.

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

SCORING STONES

CONSTRUCT & TEST A PROTOTYPE: CLAW DESIGN

- Jonas gave Ian the files that need to be 3D printed the meeting before
- Ian put the cad files of two grabber arms with different lengths in a Slicer software. Also, I printed a camera mount for the programmer for the new Intel camera we are using on the robot
- The setting for the slicer he used:
  - Perimeters/walls: 3
  - Infill: 15%
  - Layer height: 0.30 mm
  - Supports: On (for the camera mount case, the grabber arms do not need supports)
- Then, he turned the cad objects and the settings that I put for the objects to print in a .gcode file.
- After that, I turned on the Prusa i3 mk2.5 3D printed and heated the extruder and the heated bed to the temperature for pteg.
- Then, the printer calibrated itself and then started to print the 3 objects
- The first layer printed out really well but when it was printing the the second layer it started to skip lines.

PROGRAMMING ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	Fabricate and Integrate	**Tweak & Evaluate**

ODOMETRY

TWEAK & EVALUATE: PROBLEMATIC ODOMETRY PODS

While test driving the chassis last week, some of the programming and build team members realized that some issues arose regarding the positioning and security of the two odometry pods on the side of the robot. The build team will look to solve these issues this week.

The first problem that occurred was the security and endurance of the odometry pods. When the chassis is driving, any high-powered strafing that occurs may damage the odometry pods as they are not entirely secure on the robot. Strafing too fast has the potential to rip off one of the odometry pods.

Another problem that arose relates more towards odometry calculations that the programming team has been working on. While the robot moves in the vertical direction (forwards or backwards), one of the odometry wheels in the odometry pod does not rotate as the robot travels around the field. This ruins the purpose of the odometry wheels, which calculate factors such as distance travelled based off of the rotations of the odometry wheels. As a result, odometry wheels not rotating along with the ground will skew calculations done by the programming team for odometry.

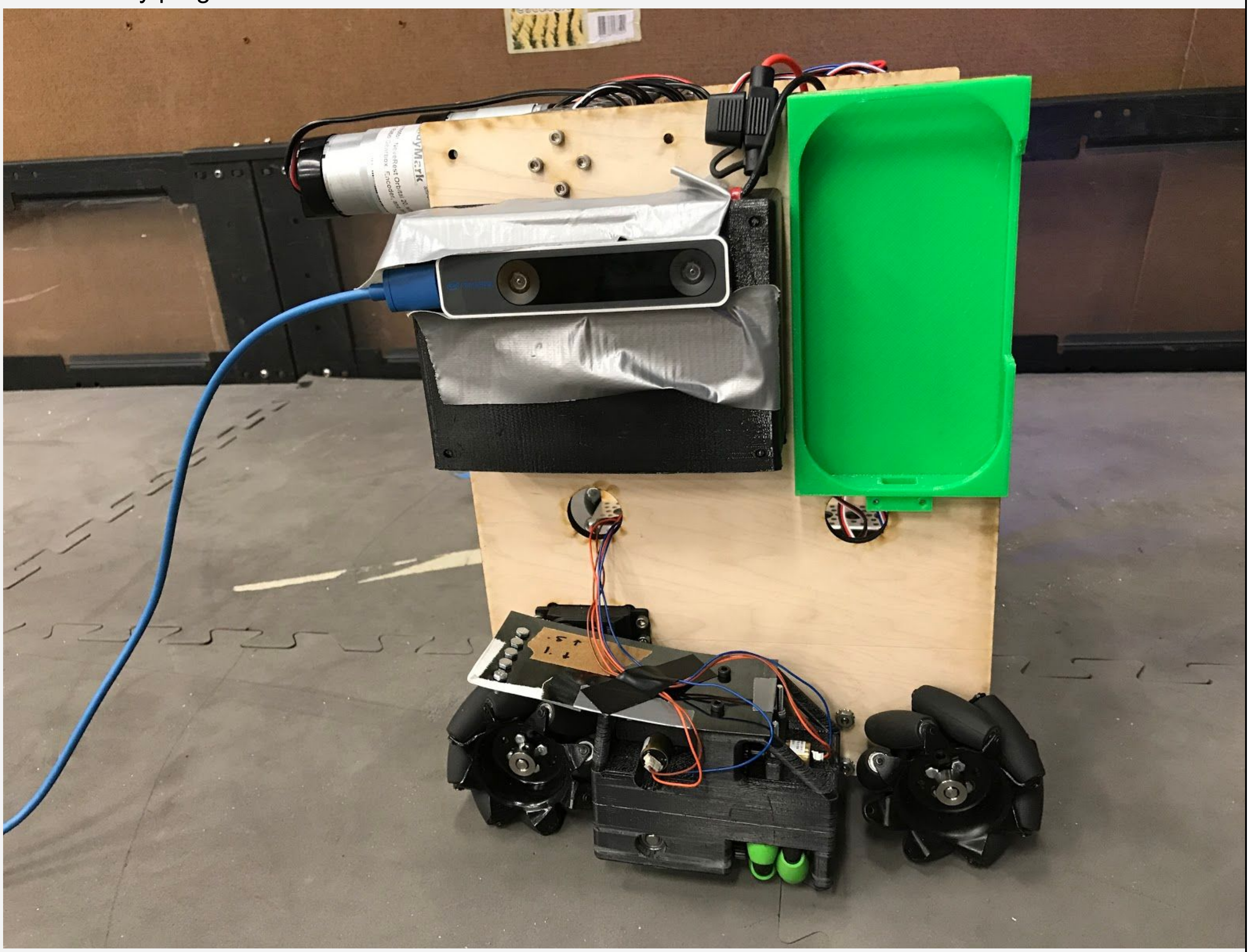
Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

CONNECTION ERRORS

DEFINE PROBLEM: INTEL CAMERA AND PHONE CONNECTIONS

In an attempt to test the Intel RealSense T265 camera with the driving chassis, the programming team connected the camera to the robot and mounted the camera temporarily. However, we soon faced several errors regarding the configuration of the camera and the connections of the phone and camera, including inaccurate initialization of code and restrictions on camera data access. When connecting the Intel RealSense T265 camera, we faced issues with access permissions of the camera.

In order to solve this problem, the programming team determined that the permissions issues with the Intel camera can be overcome through the verification of camera usage in apps on the Android phone. By verifying the apps which can use the camera, permissions were granted to the phone and could be used in the odometry program.



NON-TECHNICAL DISCUSSION

- **The Kaizen Robotics visit has been rescheduled to December 7**
- **Updated and reorganized the website layout (added new sponsors)**

Helen and Clare added new pictures to the website and added REV under the sponsorship page. Mr. Prettyman recommended that they split the team update page into separate sections so that it would be easier to share our notebook with other teams. We added a new Resources page to make navigation more straightforward.

- **We will be attending the Oxford Scrimmage event on November 16.**

While we will not have a fully completed robot by that time, we do have solid goals for what we would like to bring to this event. For the TeleOp period, we would like to have full capabilities for harvesting and dispensing Stones, though we do not expect to be able to stack yet. We are not entirely sure what our Autonomous will look like by this time, but we would like to have odometry localization implemented into the programs.

MEETING SUMMARY

- Intel Camera Debugging
- Oxford Scrimmage Goals Discussion

SATURDAY, NOVEMBER 9, 2019 MEETING

DATE & TIME: 11/9/2019 | 9:00 AM - 2:30 PM

STUDENTS: Patrick, Bryan, Karthik, Connor, Helen, Paige, Ian, Rohan, Isha, Katy, Suraj, Marcus, Aidan

MENTORS: Mr. Prettyman, Arnav

AGENDA
Scrimmage on 11/16/19 (NEXT WEEK)
Priorities Discussion

TIMELINE REVIEW

Chassis	Driveable, able to harvest and dispense by 11/16
Programming	Park in autonomous, 11/16

*The priority of finishing the Chassis timeline deadline for the Oxford Scrimmage unfortunately interfered with getting CAD finished

MECHANICAL ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	**Fabricate and Integrate**	Tweak & Evaluate

DELIVERING STONES

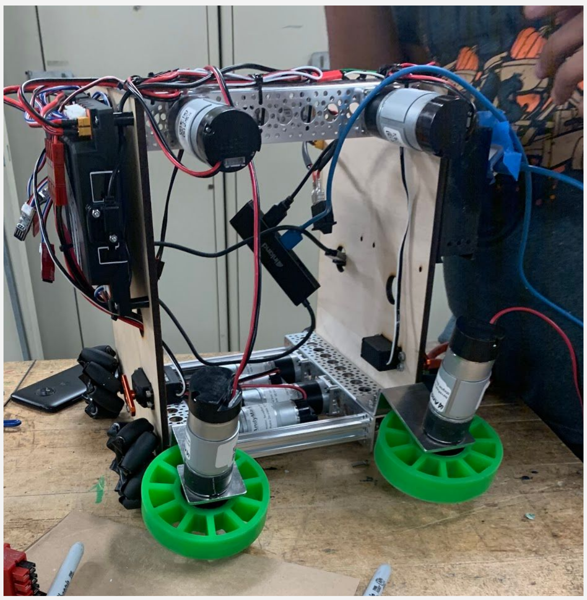
FABRICATE & INTEGRATE: ALUMINUM INTAKE

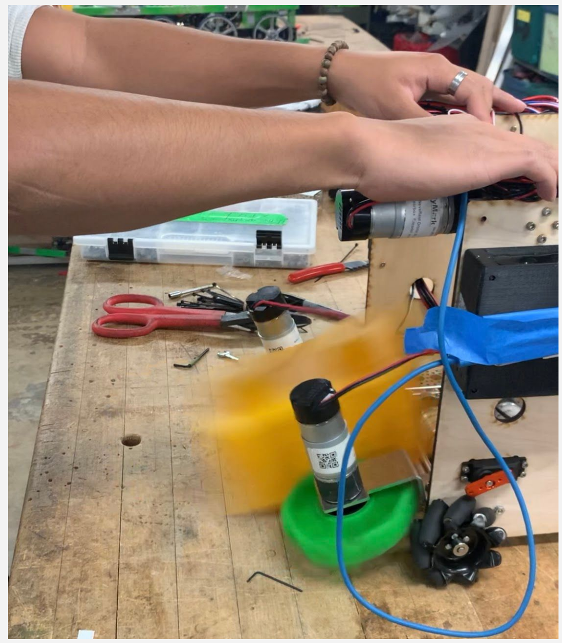
Connor printed a 2d version of the harvester part with dimensions. Then, Bryan, Arnav, and Aidan copied the design onto aluminum and started making a prototype.

We used the Measure app on our phone to get a rough estimate of the 20° intake angle. This is not the final design, so we were okay with inaccuracies.

Next, we facemounted the motors. We used 3.7:1 motors because it is a high speed and low torque application to intake blocks. We made the

We used green compliance wheels to comply to Stones. Our mounting was not properly made so the wheels were actually too far apart to intake the stones. To fix this, we cut slits into the wheels so they would splay outwards when rotating into the robot. This would add an extra half inch radius on each wheel, which was perfect for intaking the block





While this was happening, Ian 3D-printed the plastic version of the part that will be used on the robot.

- He printed it with MOE FRC's Lulzbot Taz 2 because he was also printing some other prints on the Prusa i3 MK2.5
- The setting of the Slicer he put for the print was:
    - Perimeters/walls: 4
    - Layer height: 0.20 mm
    - Infill: 10%
    - Supports: no
- Then, I sent the .gcode file to the Taz 2 3D print and it calibrated itself by homing the axises and then started printing. it was printing well. This print would not finish by the end of the meeting so we would get it the Tuesday, the 12th meeting.

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	**Fabricate and Integrate**	Tweak & Evaluate

STACKING STONES

CONSTRUCT AND TEST A PROTOTYPE: CLAW DESIGN

- After printing the two grabbers for the intake mechanism the last meeting, Ian print the piece of the intake mechanism that holds the skyblock in the mechanism with the grabbers
  - He put the .stl file of the Caded part into a Slicer software
  - The setting he used for the print:
    - Perimeters/walls; 3
    - Layer height: 0.30 mm
    - Infill: 15%
    - supports: On
  - Then, Ian tried the cad file into a .gcode file with the setting he sett for the print.
  - He turned on the Prusa i3 mk2.5 3D printer and heated up the extruder and heated bed
  - Then, the printer calibrated itself and then started printing
  - The printer printed the first layer well but when it printed the second layer the printer was not extruding for some lines of the print, which means that the printer head was moving too fast for the extruder to extrude the filament
    - So, he stopped the print to adjust the setting and he decreased the speed the print head goes and the increased the print extruder nozzle temperature.
  - Then, he reprinted the piece and the first layer printed well and then when it started to print the 2nd layer it was still skipping lines but less then before but he did not want to redo the print again.

PROGRAMMING ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

INTEL REALSENSE T265

TEST A PROTOTYPE: INTEL REALSENSE T265

In order to determine whether we could utilize the Intel RealSense T265 cameras as an odometry replacement, the programming team temporarily mounted the camera to the chassis and ran it down two floor tiles of the game field. Afterwards, we were able to see that the points and distance output given by the camera was incredibly accurate to the actual distance travelled. With these results, we have decided that using the Intel camera can be a helpful supplement to odometry.

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	**Tweak & Evaluate**

A* UNITS

TEST A PROTOTYPE: COORDINATES

After determining the effectiveness of the Intel camera and distance/location tracking, the programming team devised a new coordinate system and converted the point outputs given by the camera into units that match the A* program. Each floor tile in the game field has the dimensions 12 x 12 inches. With the A* units, each unit will be ½ of an inch, so each floor tile in the game field will have the dimensions 48 x 48 A* units. The smaller units may help with precision when programming and determining the location of the robot, and the A* units will be compatible with the path-finding algorithm.

TWEAK AND EVALUATE: UNIT CONVERSIONS

After determining the A* coordinate system above, we compared our experimental conversion to the conversion of feet to meters and saw that they were similar in nature, so we decided that we will use the feet to meters conversion for our future conversions instead. This will simplify our unit conversions and make them more applicable to the real world as this conversion utilizes measurement units that are more commonly found in society.

NON-TECHNICAL DISCUSSION

- **Oxford Scrimmage on 11/16/19**
  We wanted to make sure we had a to-do list for this scrimmage
  - Take of Odometry Wheels—Do not want to break them during scrimmage when it's currently unreliable
  - Mount Harvester so we can compete in Tele-Op
  - Foundation servo because it is quick and easy
  - Team Numbers for a legal robot
  - Tension the drive train belt because they are skipping and will harm the belts if we use for the whole scrim
  - Put encoders on wheels so the robot has positional data for autonomous
  - Mount a camera for potential autonomous

- **A new FTC team from Brazil reached out to MOE**
  - They found us on social media and were inspired, so they asked for help
  - They wanted tips on the engineering notebook
  - More information on page **E25**

- **More edits were made on the website**
  - Helen created a new page of the website that directly linked to MOE's engineering notebook from the 2018-2019 season
  - The National Chemistry Week event at the Independence School was added to the outreach page of the website

- **Katy and Helen sent out more sponsorship requests**
  - MOE reached out to JP Morgan and Chase and SolidWorks with sponsorship requests

MEETING SUMMARY

- Intake V1 Manufactured

- Oxford Scrimmage Planning
- A* Units with Intel Camera

TUESDAY, NOVEMBER 12, 2019 MEETING

DATE & TIME: 11/12/19 | 6:00 PM - 8:30 PM

STUDENTS: Clare, Helen, Connor, Ian, Karthik, Jonas, Bryan, Patrick, Rohan, Isha, Aidan

MENTORS: Mr. Prettyman, Nick, Arnav, Andrew

AGENDA
Oxford Scrimmage is on Saturday!
Look at team member slides
Review objectives for Oxford

TIMELINE REVIEW

Programming	Basic Autonomous for Oxford 11/16
Scoring Systems	Stones on foundation but no stacking for Oxford 11/16

MECHANICAL ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

SCORING STONES

CONSTRUCT AND TEST A PROTOTYPE: CLAW DESIGN

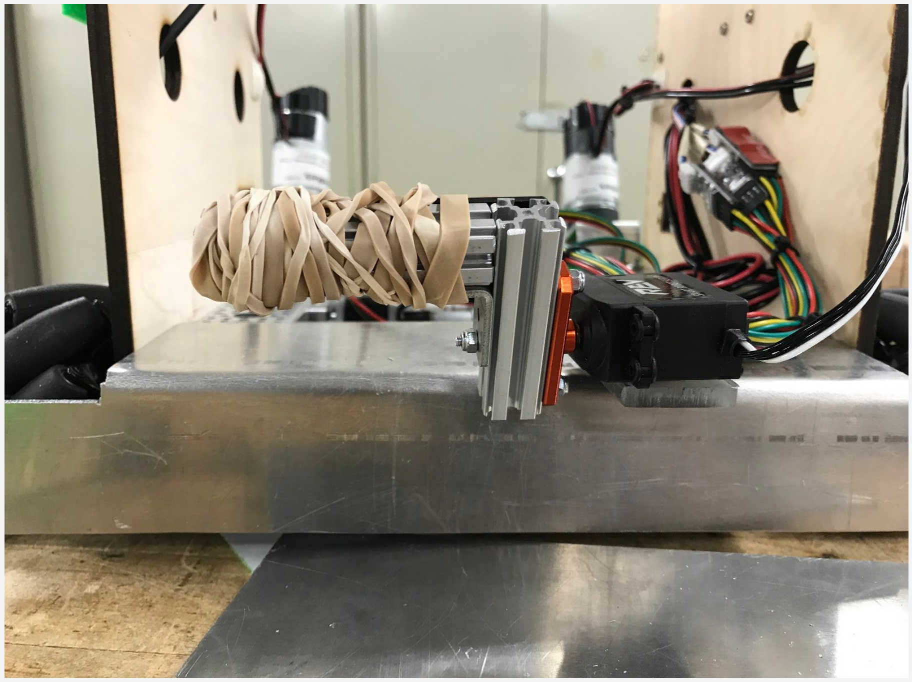
Jonas and Ian used Ian's 3D prints from the last two meetings to construct the advanced prototype of the claw design. We assembled the pieces. The support beams underneath were too weak, so we snapped them off. They snapped off from the connection between the pieces and the base was weak or there was a place where the printer under extruded or skipped a layer making the connection weak. So, We replaced them with screwed in metal pieces.

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

MOVING FOUNDATION

CONSTRUCT AND TEST A PROTOTYPE: FOUNDATION GRABBER

During the autonomous period, repositioning the foundation can help MOE earn 10 points. In order to obtain these points, the build team created a grabber that will clamp down on the foundation so the robot will be able to move the foundation easily. We decided to use a grabber so the robot will be able to reposition the foundation with both a push/pull motion necessary for both the autonomous and endgame period.

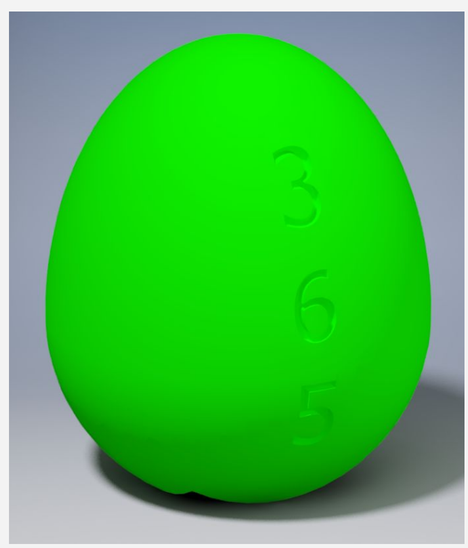


Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

SCORING CAPSTONE

DEVELOP A SOLUTION: EGG CAPSTONE

Connor started making an egg capstone in CAD because the team did not yet have a functioning capstone design. Connor also used this opportunity to teach Isha about CADding parts and she made her own version. The egg capstone is similar to an egg we made last year but it has a square hole in the bottom so it can fit on the skystones.

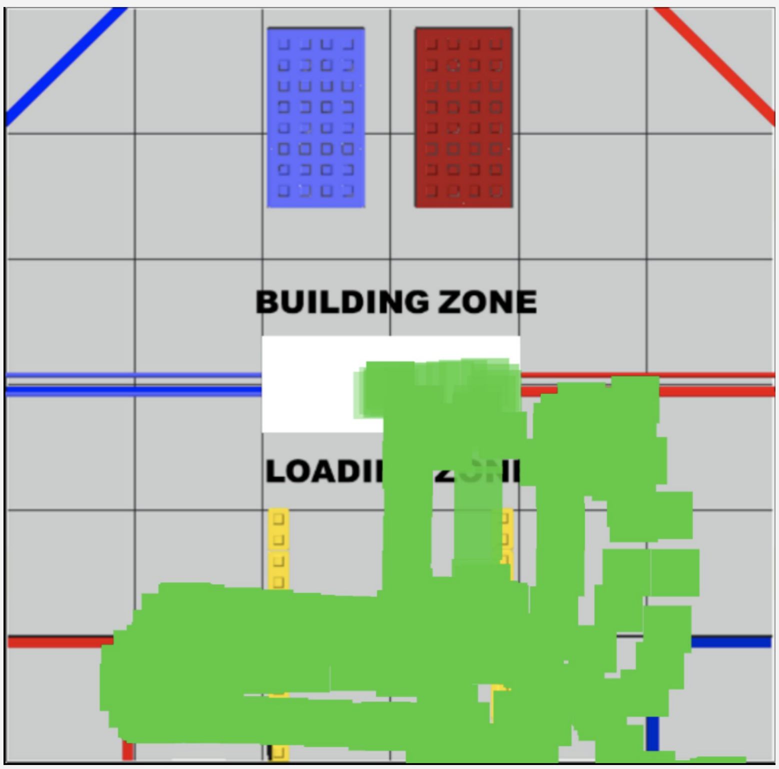


PROGRAMMING ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

ROBOT TRACKING

CONSTRUCT A PROTOTYPE: PATHING



In order to determine the path that the robot took during autonomous, the programming team used React online to build an HTML, CSS, and JavaScript program that marks the path of the robot over a period of time. As shown in the image on the left, the green lines represent the robot's movement. This can be beneficial in marking the location of the robot and determining the total distance travelled.

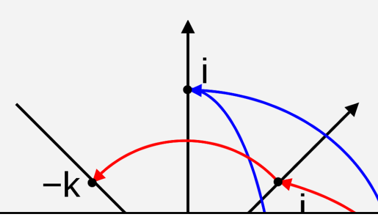
Tweaks on this should be completed that will help make the marked path more visible and easy-to-track for the team.

Define Problem	**Generate Concepts**	Develop a Solution	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

QUATERNION CALCULATIONS

GENERATE CONCEPTS: BETTER CALCULATIONS

While calculations from previous seasons have been accurate enough to run our robot, Karthik and Rohan looked into and discussed the feasibility of using quaternions in angle calculations over Euler angles. Quaternions are more accurate when compared to Euler angles. While Euler angles and quaternions are both used



to calculate angles on a three-dimensional field, quaternions utilize four input angles while Euler angles utilize three input angles.

One major disadvantage of Euler angles is the limitation present surrounding the “Gimbal lock” phenomenon, where the robot or mechanism has two axes that become parallel and therefore only has the freedom to move on two axes. The RealSense Camera uses quaternions for angles so we must be able to use this in our odometry algorithms.

The programming team decided to implement quaternions in robot angle calculations to prevent “Gimbal lock” and create calculations that are more precise.

NON-TECHNICAL DISCUSSION

- **Oxford is a checkpoint!**

Team plan, team bios, and judging presentation all have goals for Saturday.
Our primary goal is for new members to get competitive experience! We also want to see where we are compared to other teams and use the opportunity to share our designs/concepts to other teams and learn for other teams as well.

- **Mr. Prettyman scheduled the Delaware meets.**

The first meet is on December 5.

- **We may need an extra meeting for programming, drive practice, and packing this week.**
- **We will do a team SWOT analysis next Tuesday.**
- **Hagley STEM-Tastic Weekends reached out to us.**

The dates are January 18, 19, and 20, January 25 and 26, February 1 and 2, on 11 a.m. – 3 p.m., Visitor Center 2nd Floor. We are planning on scheduling groups of students for each date.
We may invite other Delaware teams to help us, such as Razor Steel, X^2 Factor, or Hiller Instinct.

MEETING SUMMARY

- Oxford Scrimmage preparation
- Last-minute details and additions to the robot
- Live Pathing
- Quaternion Calculations

FRIDAY, NOVEMBER 15, 2019 [EXTRA] MEETING

DATE & TIME: 11/15/19 | 5:30 PM - 9:00 PM

STUDENTS: Bryan, Patrick, Karthik, Helen, Rohan

MENTORS: Mr. Prettyman, Arnav, Andrew

AGENDA
Finish preparations for Oxford scrimmage tomorrow
Pack for scrimmage
Prepare basic notebook

TIMELINE REVIEW

Programming	Basic Autonomous for Oxford 11/16
Scoring Systems	Stones on foundation but no stacking for Oxford 11/16

MECHANICAL ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	**Fabricate and Integrate**	Tweak & Evaluate

CHASSIS

FABRICATE AND INTEGRATE: LEGAL ROBOT

To ensure we were a legal robot, we still needed places for the Alliance Markers and the team numbers. Patrick quickly made small team number plates with Velcro hanging off for the Alliance marker. We duct taped that to both sides of the robot for a quick solution.

The duct-tape was not the sturdiest, but we planned to have our team number on bumpers that will be added later to the robot, so we didn't want to make new holes into our side panels.

We used the AndyMark Alliance Markers that we bought in the beginning of the season.

The Alliance Markers have a special home in the Mobile Pit: A box we take with our cart into queuing with essentials. This means that if we accidentally forgot to switch our alliance markers, we can quickly switch before the match starts.

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	**Fabricate and Integrate**	Tweak & Evaluate

SCORING STONES

FABRICATE AND INTEGRATE: TEMPORARY STONE OUTTAKE

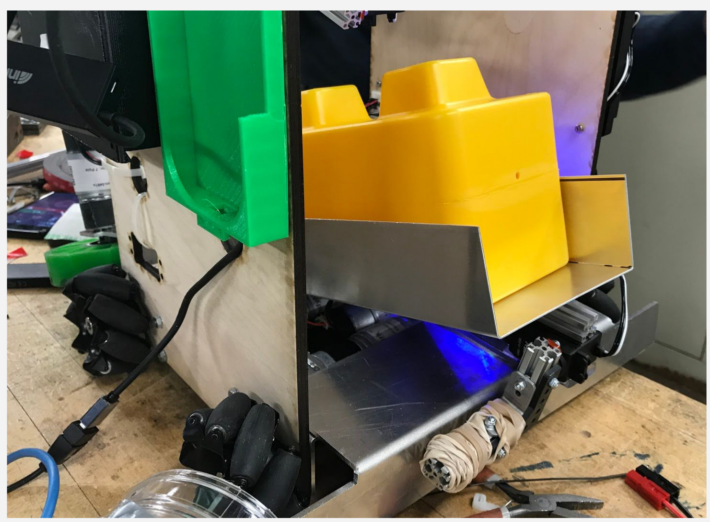
When the stone reaches the inside of the robot, a metal arm with a separate servo will reach around the back of the stone and push the stone up the remainder of the ramp for dispensing.

With the arm, the dispenser motors will have a slower speed that will leave the stone in the middle of the robot ramp. The arm allows us to have more control over the stone's movement so it will not overshoot out of the robot. In the image on the right, the arm is depicted in its extended state while the image below depicts the arm in its resting location.

We only wanted a quick solution for this because our final mechanism will be the outtake claw, which will have much more control but it needs more planning and designing. We believed that it was not worth the effort designing a claw for one scrimmage, and we will be patient for a more final result.

CONSTRUCT AND TEST A PROTOTYPE: RAMP

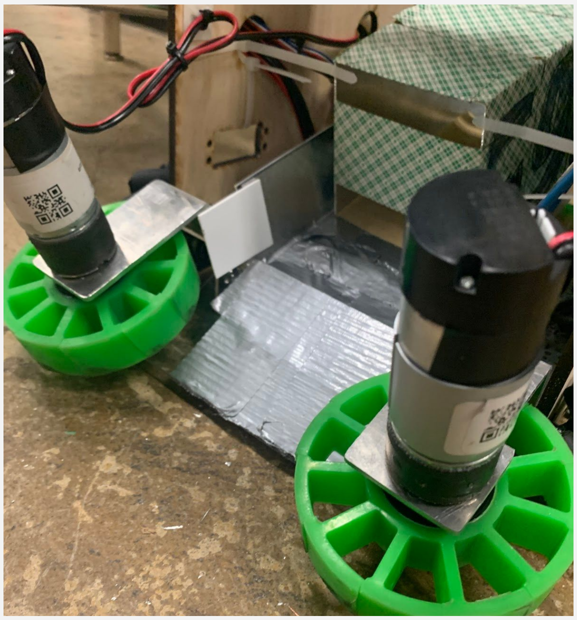
Although the build team had constructed and attached a functioning harvester on the robot, we realized that we would need a way to transfer the harvested stone from one side of the robot (harvester) to the opposite side (lift/dispense). Bryan and Arnav decided that an inclined ramp will be the best option for stone transfer.



Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	**Fabricate and Integrate**	Tweak & Evaluate

SCORING CAPSTONE

FABRICATE AND INTEGRATE: CAPSTONE



Instead of spending time to make a form of actuation for scoring the capstone, we thought it would be easier to make a capstone that works with a mechanism we already have: the intake system. This means we will not have to make a whole new mechanism just by spending more time on making a compatible Capstone. Our Capstone design takes the general shape/size of a stone using a piece of aluminum. Green and white tape was placed around it for decoration and our team number with written with sharpie.

PROGRAMMING ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	**Fabricate and Integrate**	**Tweak & Evaluate**

CODE EDITS AND DEBUG

FABRICATE AND INTEGRATE: FOUNDATION GRABBER

On Tuesday, the build/mechanical team attached a foundation grabber to the harvester side of the chassis that will clamp down on the foundation to help the robot move the foundation in a push/pull motion. The programming team edited code for the foundation grabber so that the robot will be able to move the foundation during the autonomous period.

TWEAK AND EVALUATE: HARVESTER

After the attachment of the harvester on the chassis, the programmers wrote code for the motors on the harvester. Throughout the meeting, the speed of the harvester motors were changed and lowered in the range of 0-1 as the mechanical team tested the abilities of the harvester with an actual stone.

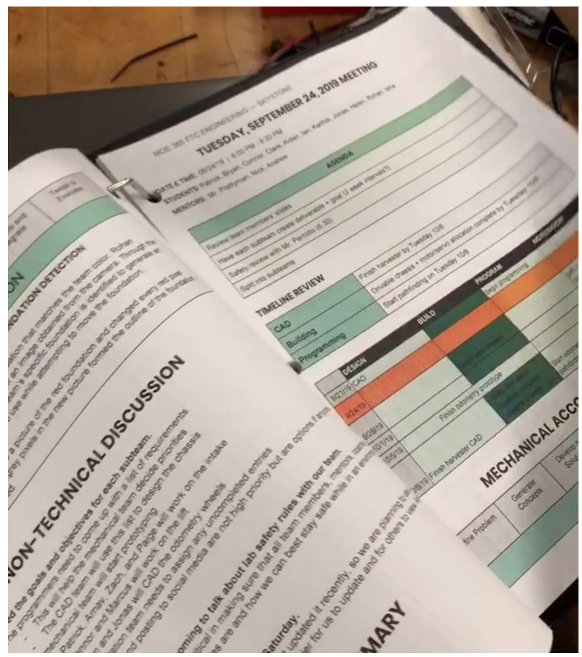
TWEAK AND EVALUATE: DEBUGGING

Since MOE is attending the Oxford scrimmage tomorrow (November 16), the programming team edited the code for the Intel RealSense T265 camera and the harvester in order to complete some tasks during the autonomous period.

NON-TECHNICAL DISCUSSION

- **First Printout of the Notebook**

We wanted a copy of the notebook to be judged at the Oxford Scrimmage. Many of the pages were not fully completed, but we wanted something to present and build off of. The formatting of this years notebook is noticeably cleaner and more readable than last years. It is more space efficient with pictures vs words and it overall looks better.



- **Patrick created a cover page and section dividers for the notebook.**

The engineering notebook for the 2018-2019 season was less organized than the notebook for this season. To make the MOE notebook more easy-to-read and aesthetically appealing, Patrick designed section dividers and a cover page that will look more professional as compared to the dividers in last year's notebook.

- **More social media posts were created on the MOE accounts.**

In preparation for the Oxford scrimmage tomorrow, Helen posted on the social media accounts to inform FTC teams in the area about the event. MOE hopes to reach out to new teams at the scrimmage!

MEETING SUMMARY

- Temporary Capstone
- Temporary Outtake
- First Notebook Printout
- Begin drive practice

TUESDAY, NOVEMBER 19, 2019 MEETING

DATE & TIME: 11/19/19 | 6:00 PM - 8:30 PM

STUDENTS: Clare, Patrick, Bryan, Ian, Karthik, Helen, Rohan, Jonas, Aidan

MENTORS: Mr. Prettyman, Nick

AGENDA
Meeting with Juliette's Revenge (#14851)
Reflections from the Oxford Scrimmage
Planning deliverables/deadlines for next 4 weeks

TIMELINE REVIEW

Lift	Ordered by 11/23, built by 11/30, tested on 12/3
Claw	CADed by 11/23, built on 11/26
Harvester	Ordered by 11/23, prototype built on 11/30, tested on 12/3
Programming	Camera vision by 11/23, Pure Pursuit by 12/7

MECHANICAL ACCOMPLISHMENTS

Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	**Tweak & Evaluate**

DELIVERING STONES

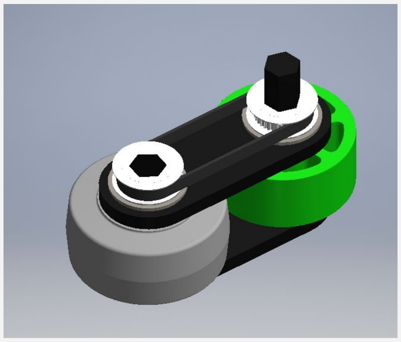
TWEAK AND EVALUATE: INTAKE PERFORMANCE AT SCRIMMAGE

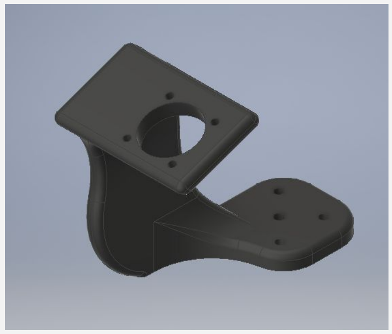
After participating in the Oxford scrimmage over the past weekend, we were able to test our robot among other teams in the area. While at the meet, we realized that the harvester wheels hit the mecanum wheels on the side of the robot when running. This could potentially harm the movement of the robot when driving. Additionally, the intake wheels were able to harvest blocks well, but they did not put them far enough in the robot.

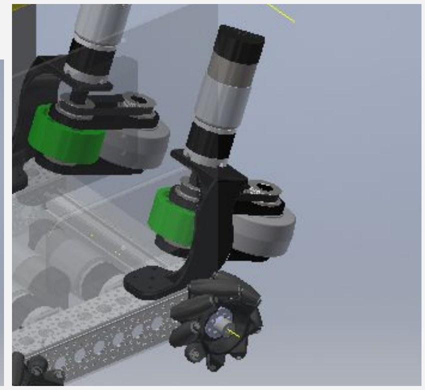
To counter this issue, Bryan designed a new CAD that utilizes two intake wheels on each side of the robot (four wheels total). This would benefit our robot as the smaller intake wheels will not run into the mecanum wheels while driving. In addition, having two wheels allows for more control over stones while harvesting during a match because it can go directly into the robot. The two wheels also provide more surface area to grab the block with.

DEVELOP A SOLUTION: REDESIGNED INTAKE

Based on the performance of the intake at the meet, we designed a new two wheel harvester. Other than the benefits listed above, it is also more compliant because it is capable of passively opening and closing to comply to the shape of the Stone, while the two wheels on each side ensures that the block reorients into the right position.







The outside wheels are small Colson wheels. They are hard and provide more friction, but have the compliance of the passive opening. They torque of the belt spinning inward pulls the colson wheels in, but has a hard stop from going too far close to each other. Then the pressure of the block going will cause the wheels to open and comply to the shape of the Stone

The next wheels are compliant, squishy wheels. They are mounted at a fixed distance away from each other, but provide still provide compliance through its forgiving material. This is so the Stone does not struggle fitting perfectly inside the robot.

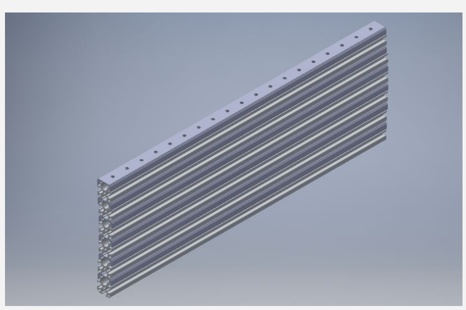
Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

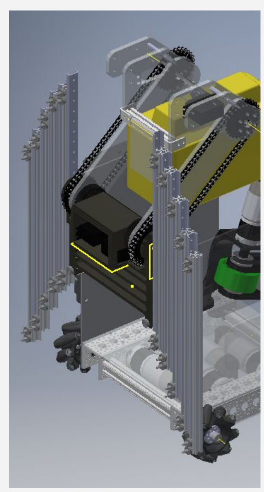
STACKING STONES

DEVELOP A SOLUTION: REV ULTRASLIDES LIFT

We CADed our lift to use REV UltraSlides. Their REV V2 worked pretty well for slides, but now these ones have bearings so they will possibly perform better.

We plan two sets of these slides on each side of the robot to get more stability when raising the lift.



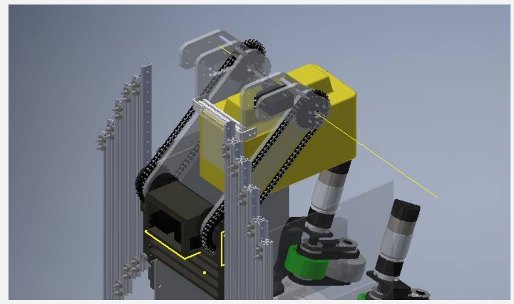


Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

SCORING STONES

DEVELOP A SOLUTION: VIRTUAL FOUR BAR

To take the stone from inside the robot to outside the robot we plan to use a virtual four bar (or v4b for short) because its ability to keep the stone parallel to the ground when rotating. It would be servo powered because a motor would be very heavy to lift.



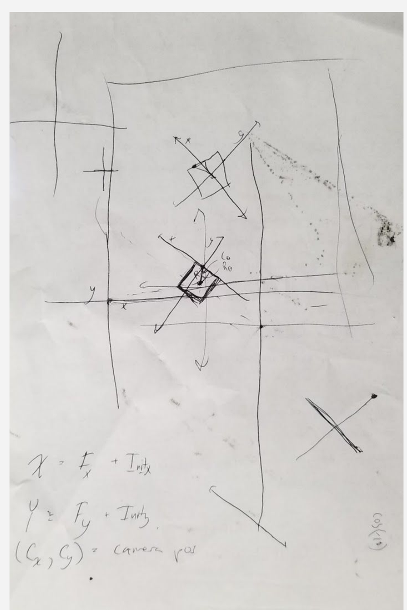
PROGRAMMING ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

SLAM CAMERA

TEST A PROTOTYPE: PATHFINDING AND ANGLES

The programming team started running tests to determine if we can extract robot angles from the Intel RealSense T265 camera accurately, without having to calculate angles by hand. Based on these tests, the angles generated by the camera seem to be precise and true to the original values. The continued testing of the Intel camera helps the programming team with making the decision to replace odometry. Accurate angle test results from this meeting further support the use of Intel cameras over odometry.



Meanwhile, Rohan continued to work on pathfinding algorithms and improved existing code regarding the pathfinding abilities of the robot.He looked at the PurePursuit algorithm. Additionally, Rohan did math on how to use the data from the Intel camera to get the robots position on the field. To localize, the steps are as follows:

1. Get the position data from the SLAM camera (x, y)
2. Get the heading (orientation) data from the SLAM camera (degrees)
3. Add a vector to the position to convert to the center of the robot
4. Rotate this position to convert to a point relative to the field (rather than the camera's axis)

5. Add in offsets

3D PRINTING

- Ian worked on getting the setting right so that the print the carbon fiber petg filament pretty well or perfectly
  - At home, he researched how to print with carbon fiber petg and the site said to print with it slowly and to decrease the print speed between 25% and 50%. So, he decreased the print speeds before the meeting.
  - At the meeting, he started to do test prints with the 20 tooth pulley print.
    - The first pulley print printed out pretty well with a few layer skips. Also, on the print, the first layer smushed out more the print's dimensions, called elephant's foot.
    - For the second print, he adjusted a setting to get rid of the elephant's foot on the print and when it printed the piece again it got rid of it.
    - For the third print, he decreased the perimeter print speeds but will the extruder printed it the extruder stopped printing, maybe from filament globbing up on the extruder tip.

NON–TECHNICAL DISCUSSION

- **Mr. Prettyman signed us up for 4 Delaware meets and a Hagley event on January 20**
- **Oxford Scrimmage Discussion**
  - Learning event for new students
  - Connection issues led to MAJOR problems
  - Morale kept high despite losing all games
  - *More discussion on page E28*
- **Secondary Priorities:**
  - Many members find it hard to do stuff (more stuff)
  - Second Chassis
  - Batterbot (some details)
  - Important for skill development and
- **Batterbot updates**
  - REV
  - Other stuff
- **Team #14851 Juliette's Revenge will visit us tonight. More information on this outreach on page E31**
- **Edits for the Notebook (suggested by Lena Dillard during the Oxford scrimmage)**
  - Add dividers between sections for better organization
  - Note any new sponsors from this season
  - Potentially include a section for each part of the robot (CAD designs, past iterations, etc.)
  - Update the budget section (use spreadsheet)
- **Ian came up with an idea for an outreach with Printed Solid.**
  This is a local company involved with 3D printing. We will reach out to them on Saturday.
- **Helen wrote a template for emails to organizations about outreaches.**
  MOE will try to host and participate in more outreaches this season to teach and motivate our community to delve further into robotics.

MEETING SUMMARY

- Intake V2 Design
- Ultraslide CAD
- SLAM Positioning Math

SATURDAY, NOVEMBER 23, 2019 MEETING

DATE & TIME: 11/23/19 | 9:00 AM - 2:30 PM

STUDENTS: Karthik, Helen, Bryan, Patrick, Suraj, Clare, Ian, Connor, Jonas, Paige, Aidan. Rohan

MENTORS: Mr. Prettyman, Arnav, Andrew

AGENDA
Check in with deliverables assigned for today
Lights are not working - meet directly in the lab

TIMELINE REVIEW

Lift	Ordered by today, built by 11/30, tested on 12/3
Claw	CADed by today, built on 11/26
Harvester	Ordered today, prototype built on 11/30, tested on 12/3
Programming	Camera vision finished today, Pure Pursuit by 12/7

MECHANICAL ACCOMPLISHMENTS

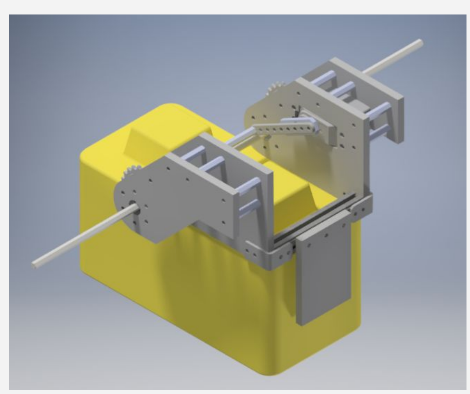
Define Problem	Generate Concepts	**Develop a Solution**	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

SCORING STONES

CONSTRUCT & TEST A PROTOTYPE: CLAW CAD

Jonas spent time this week finishing the CAD for the newest claw design. We then implemented it onto the CAD of the rest of the robot to see how it would fit inside the chassis.

This would mount to Bryan's Virtual 4 Bar Design. It will hold one of the nubs of the stone.

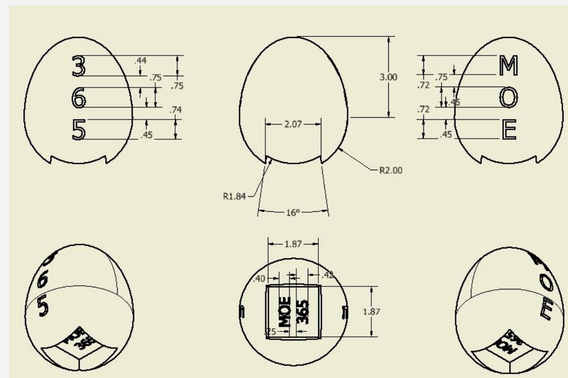


Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

SCORING CAPSTONE

DEVELOP A SOLUTION: EGG CAPSTONE DIMENSIONS

We had a lucky egg last year that we took to Delaware States. We were planning to use it for last year's team marker except it would roll around too much. This is what it would look like as the team scoring element this year.



Define Problem	**Generate Concepts**	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

BATTER BOT

DEFINE PROBLEM: BATTER BOT

The Batter Bot we have used for outreaches for the past few years doesn't work well anymore because it uses outdated electronics. We want to make a new, sturdier batterbot using REV Expansion hubs to decrease electronic problems and have smoother outreaches.

Criteria:
-REV Expansion Hub electronics

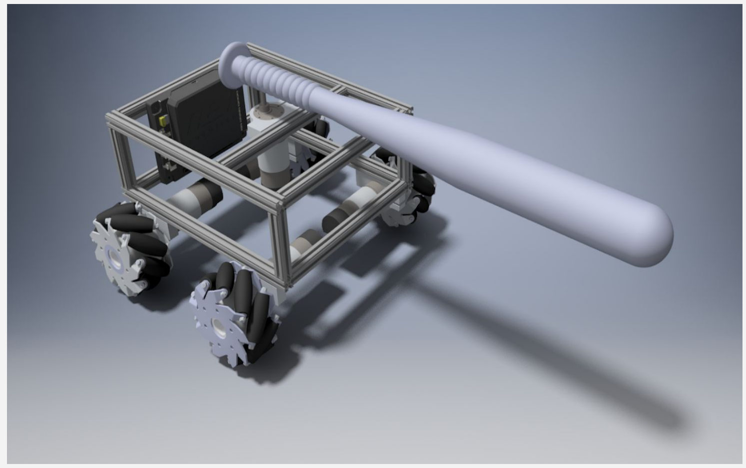
Constraints:
-Small like the old batter bot

GENERATE CONCEPTS: BATTER BOT UPGRADES

We decided that we wanted this new batterbot to use mecanum wheels unlike our previous batter bot. This is somewhat more intuitive to drive because drivers have more control of its motion.
We also decided to use REV extrusions instead of Tetrix. The REV Expansions hubs should mount easier to this, but it will also be less bulky and more appealing.

DESIGN A SOLUTION: BATTER BOT CAD

Connor, Paige, and Aidan designed and CADded the new Batter Bot. Using the ideas we created while brainstorming, they designed a robot that fit the criteria and constraints. With four mecanum wheels, we realize that we needed 5 motors total. Since an expansion hub only fits 4 motors, we will need another one or a Sparks Mini Controller.

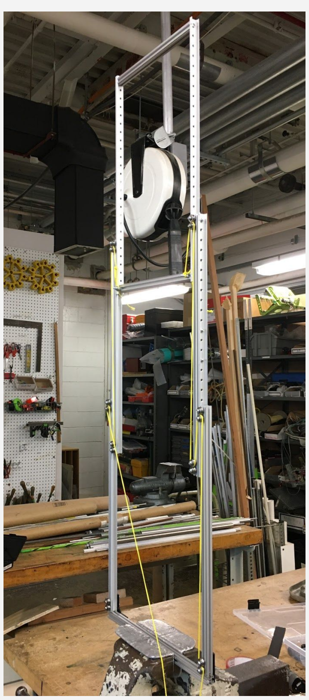


The CAD is mostly complete except for the brackets connecting the REV beams and we don't have a method to attach the bat yet, although we could just use the same method as the old battrer bot, which uses a Tetrix channel with the bat inside it.

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

STACKING STONES

CONSTRUCT & TEST A PROTOTYPE: LINEAR SLIDES



Jonas, Suraj, and Bryan worked on assembling and testing the REV Ultra slides. We attached the pulley components and used fishing line to string them. We made two of them because we plan to use two sets of slides for the vertical lift. We cannot use these ones because they are too long but if our tests shows positive results, we will buy the shorter ones.

In our testing, we saw that it lifts very smoothly but we did have problems stringing it. This can easily be fixed with pulley guards. Additionally, these slides were easy to assemble. We are highly considering buying the shorter variant so we can fit under the neutral bridge.

PROGRAMMING ACCOMPLISHMENTS

Define Problem	Generate Concepts	**Develop a Solution**	Construct & Test a Prototype	Fabricate and Integrate	Tweak & Evaluate

PID CLASS

DEVELOP A SOLUTION: GENERIC PID

The programming team started developing PIDs for the robot's movements. PID stands for proportional-integral-derivative controller. In more general terms, the PID works by taking in the movement values of the robot and performs calculations based off of the three categories to account for the error in movement and present responsive corrections to this movement error. The programming team decided to use a PID to counter the slight errors in position after the robot moves. One of the problems that may arise is the issue of driving past the point where the robot is supposed to move. For example, if the driver control tells the encoder of the wheel to move forward by a certain distance, the robot will reach that distance and then stop its motor movement. The robot continues to travel a small distance as the motor reduces its speed to stop. The PID removes this margin of distance error by proportionally reducing the motor speed as the robot gets closer to the target location.

Previously, the team used Pure Pursuit, another method of field navigation; however, this restricted the robot's movements to a tank drive model. Additionally, for a new robot, Pure Pursuit would take significant amounts of time to calibrate and test. By using a positional PID, development time could be reduced, and the robot's strafing capabilities could be utilized.

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	Fabricate and Integrate	**Tweak & Evaluate**

DEBUG SLAM LOCALIZATION

TWEAK & EVALUATE: SLAM DEBUG

The programming team decided to rotate the axes of the field earlier and had to debug the program for movement in order for the position and localization values to be accurate. In addition, the mechanical team moved the SLAM camera, so the values of the camera's offset had to be updated in order for the localization data to be accurate.

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	Fabricate and Integrate	**Tweak & Evaluate**

UPDATED TELEOP DRIVE CONTROLS

TWEAK & EVALUATE: TELEOP CONTROLS

After the mechanical team attached the harvester onto the robot, the programming team updated the

TeleOp controls so the harvester will be able to harvest while driving.

Another useful control that the programming team decided to add to the drive controller is the ability to slow down the robot's drive speed at certain points in the game or when driving in general. If the driver holds down the right trigger on the controller, the robot will drive at a smaller power so it can travel slower. This may be useful when trying to harvest stones that are in awkward locations.

3D Printing

- Ian was working to get the setting of the Slicer program profile of the print to print the Carbon Fiber filament
  - He did this by printing the 12 tooth pulleys for the robot to see if the setting are correct for printing the filament
  - Then, he did a first layer calibration test because he saw that the first layer filament was really hard to get off so he raises the z height from -0.640 mm to -0.590 mm
  - Then, he got back to printing the pulleys to continue to adjust the settings. They were printing almost perfectly with a little layer skipping and the first layer does not stick too well so I can not get it off.

NON-TECHNICAL DISCUSSION

- **It's the twins' birthday!**

- **We held a full team SWOT analysis brainstorming.**

	PRESENT	***FUTURE***
+	**STRENGTHS** - engineering documentation content, on time - explaining/tracking decisions - helping Delaware teams - ambassador for spreading FIRST - mentors - number of students -student experience	**OPPORTUNITIES** - engineering documentation process(calculations, numbers, more objective) - add summary of progression - emailing companies/looking for more events - emphasize new connections/get mentor bios - document existing connections - document future plans - get more team members trained in the notebook - pass down skills - reshape outreaches, have a clearly defined purpose - host meets? - recruit mentors for other teams, create 15 minute presentation and find engineering groups - document game strategy - marketing - plan ahead, schedule extra time
-	**WEAKNESSES** -CAD quality - team plan finances(fix with budget details) - bios(add mentor bios) -getting new connect opportunities -documenting existing connections - only document after the fact - student mechanical experience -drive practice	**THREATS** -graduating team members - lack of local development of DE teams - lack of qualifiers in surrounding states - lack of time for drive practice/programming

MEETING SUMMARY

- Started Custom PID Class
- Update Tele Op Drive Controls
- Debugged SLAM Localization
- Tested REV Ultraslides
- CADed New Batterbot
- Egg Capstone Design
- Team SWOT analysis

TUESDAY, NOVEMBER 26, 2019 [EXTENDED] MEETING

DATE & TIME: 11/26/19 | 2:45 PM - 8:30 PM

STUDENTS: Patrick, Bryan, Rohan, Isha, Jonas, Karthik, Ian, Clare, Paige, Connor

MENTORS: Mr. Prettyman, Arnav

AGENDA
Review slides
December 5/7 meets
Update for deliverables scheduled this week

TIMELINE REVIEW

Claw	Built by Saturday, tested by Tuesday
Harvester	Built by Saturday, tested by Tuesday
Odometry	Build and test by Saturday

MECHANICAL ACCOMPLISHMENTS

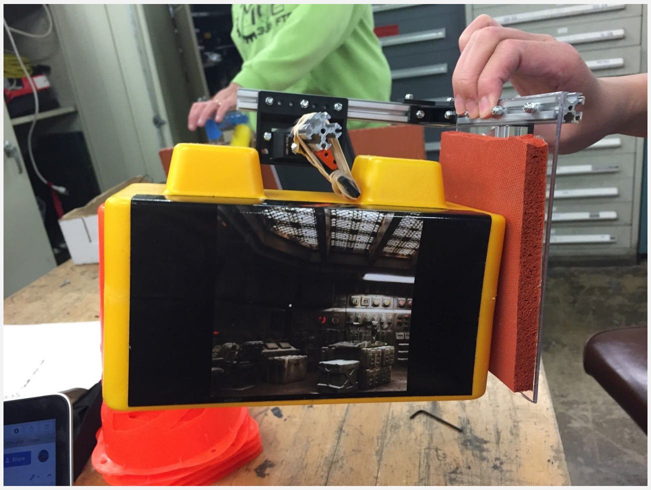
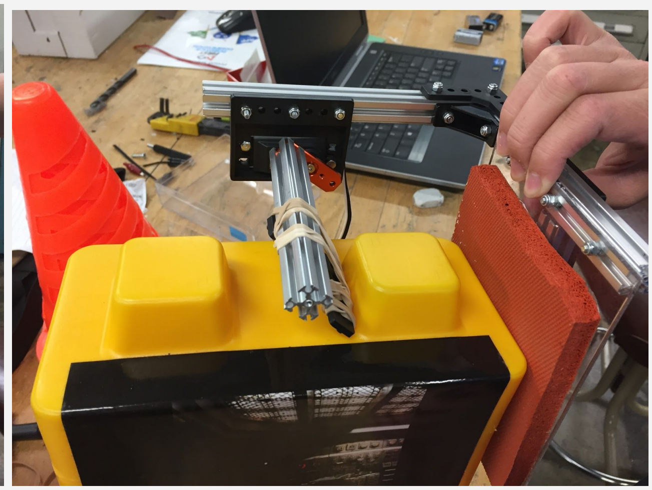
Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	**Fabricate and Integrate**	Tweak & Evaluate

STACKING STONES

FABRICATE AND INTEGRATE: CLAW DESIGN

Jonas and Ian worked on building a prototype of the claw design based off of Jonas' CAD design. We used a foamlike rubber pad for the flat surface and wrapped the claw piece with rubber bands to give it extra grip. By angling the claw in a downward way, we allowed for the claw to hold the Stone very securely and with an upward force from the servo.

One of the issues we faced was the fact that the flat surface with the rubber foam kept bending away from the Stone and only came into contact with it at a small point along the top of the Stone. To fix this, we tried to brace it with a REV channel and used 3M tape to secure it in a stiff position.

Using the REV channel to brace the back surface worked very well.

Even without powering the servo, the claw held onto the Stone securely, even when the device was lifted and shaken. The only time the Stone dropped was when the claw was tilted sideways over 80 degrees, which should not pose an issue when the claw is mounted upright onto the robot.

Jonas then tested the device with a servo programmer.

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	**Fabricate and Integrate**	Tweak & Evaluate

DELIVERING STONES

FABRICATE AND INTEGRATE: INTAKE PARTS

Our orders shipped in, but we did not have time to start any major fabrication for the intake. The intake mounts was 3D Printed.
We also have the acrylic intake plates, but we would prefer that these are machined in aluminum so that they do not break if the robot runs into the wall.
We organized the orders to be fabricated on an extra meeting.

Define Problem	Generate Concepts	Develop a Solution	Construct & Test a Prototype	**Fabricate and Integrate**	Tweak & Evaluate

BATTER BOT

FABRICATE AND INTEGRATE: BATTER BOT UPGRADE

- Connor finished making the Cad for the BatterBot
- Then, Ian, Jonas, Isha, and Connor were looking for all the parts and materials that we need for building the BatterBot.
  - For the rev extrusion pieces, they could only find one rev extrusion that was one of the lengths they need. For the rest of the rev extrusions, they mark the length they need on long rev extrusions and then, Andrew, Byran, Jonas, and Ian cut them with the band-saw.
- After that, they started building the Batterbot like the one Conner designed in Cad. They connected the rev extrusions with conner and L brackets.

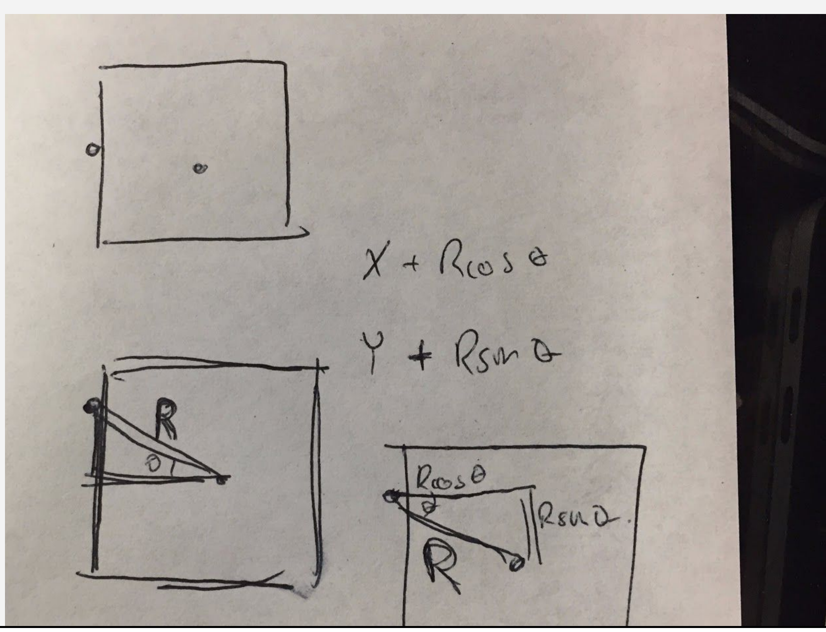
PROGRAMMING ACCOMPLISHMENTS

Define Problem	Generate Concepts	Develop a Solution	**Construct & Test a Prototype**	Fabricate and Integrate	Tweak & Evaluate

SLAM CAMERA

CONSTRUCT & TEST A PROTOTYPE: SLAM CAMERA LOCALIZATION

The goal for today was to test the SLAM camera and fix the disconnection problem.



Rohan and Karthik worked on testing the SLAM camera, which is positioned in a mount at the front of the robot, to see how accurately it could position (localize) the robot.

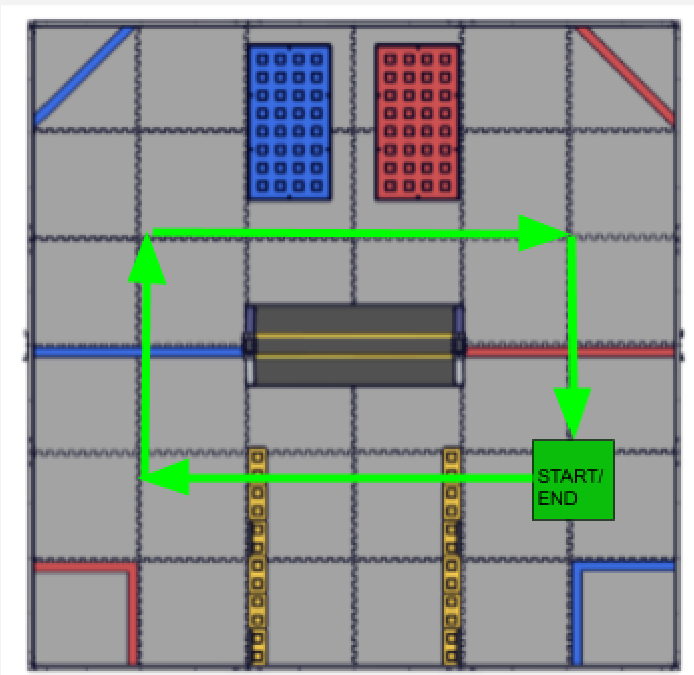
To create this SLAM localization program, we created some calculations shown on the right to be able to calculate our distance from objects based off of the values that the camera provides to us.

We needed to decide whether we wanted to form a rough autonomous using odometry wheels or the SLAM camera for the December 5th and 7th qualifiers. This is a high priority task because if the SLAM camera does not pass these tests, we will need to tell the mechanical team to update and mount the odometry pods.

In order to test the accuracy of SLAM localization, we decided on using a few different tests. First, we did some basic tests by having the robot drive a short, standard distance by using the camera to keep track of how far the robot had travelled.

When we had the robot drive distances of 6” and one tile (18”), the movements were fairly accurate. The error range was approximately 1” for the 18” distance.

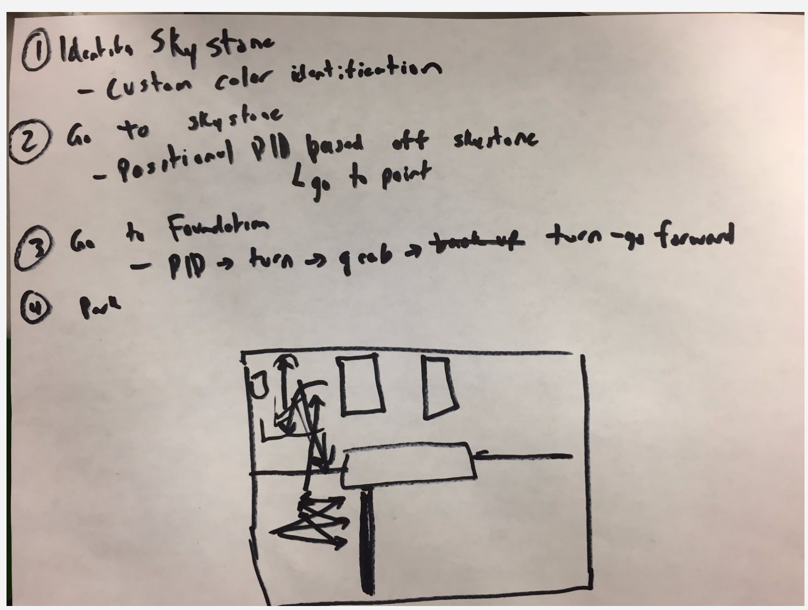
Our second test consisted of planning a path around the field and then having the camera navigate back to the original position. This test is mapped on the Field Diagram below.



The robot was able to complete the path and end very close to the position it started with. The error range for the entire path over multiple trials was estimated at 3”.

Based on these results, we are optimistic about using the SLAM camera. We will use this to program the autonomous for the early December meets, meaning that we will not need the mechanical team to remount the odometry pods.

After concluding these tests, we started planning the autonomous programs that we would like to have by the December meets. We listed the steps and drew out the basic paths that we will be programming on Saturday.



NON-TECHNICAL DISCUSSION

- **Mr. Prettyman, Helen, and Mrs. Ho went to Hagley to see where the MLK outreach is**
- **We are registered for the Towle meet on December 5**
- **We were invited to a New Jersey meet on December 7**
  - Goal for Auton - Skystone delivered, foundation moved, and park
  - Goal for mechanical - harvest, odometry wheels on

MEETING SUMMARY

- Intake V2 Fabrication
- Grabber Prototype
- SLAM Localization Testing

FRIDAY, NOVEMBER 29, 2019 [EXTRA] MEETING

DATE & TIME: 11/29/19 | 1:00 PM - 7:30 PM

STUDENTS: Patrick, Bryan

MENTORS: Arnav

AGENDA
Fix Drivetrain Pulleys
Fabricate New Intake
CAD Linear Slides

MECHANICAL ACCOMPLISHMENTS

Define Problem	**Generate Concepts**	Develop a Solution	Construct & Test a Prototype	**Fabricate and Integrate**	**Tweak & Evaluate**

SCORING STONES

FABRICATE AND INTEGRATE: INTAKE FABRICATION

Because we could not get the CNC machine working last Saturday, we looked at other options for making our intake plates . We already have an acrylic version, but we are worried that it may shatter if we run into a wall.

An FRC mentor used his CNC machine at his house, so we could get the mounts to be made of aluminum. We then did extra hand machining to get more precision for fitting the bearings into the holes.