Meeting #1

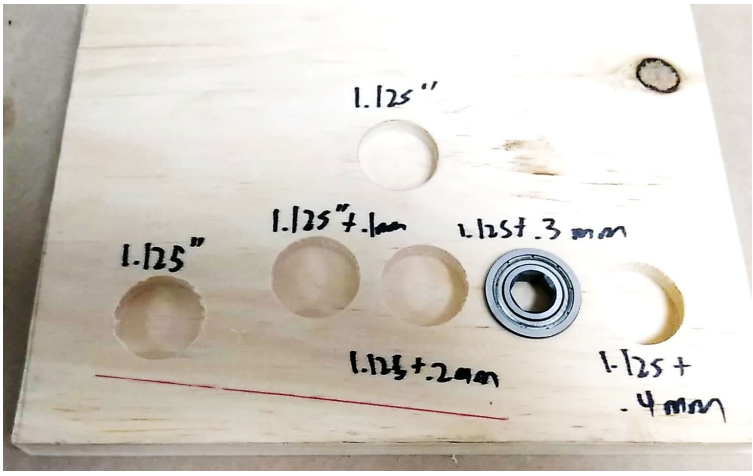
Authors: Matthew

OBJECTIVES:

1. **CNC Router setup**
2. **Figure out CAM**
3. **Figure out work-holding**
4. **Figure out tolerances**

PROGRESS:

- Decided to use Fusion360 for cam because it had a post processor for our shapeoko machine pre loaded
    - Used feeds and speeds found online for our respective machine and material
    - Devised a system using double sided tape and masking tape to use as workholding
    - Temporary solution: we will look into a threaded wasteboard in the future
- Machined bearing holes in a piece of wood to test tolerances
    - Machined 5 holes, one with no extra tolerance added, and then 4 more with .1mm more each
    - Found that +.1 and +.2 mm were press fit, and any greater was a loose fit



FUTURE PLANS:

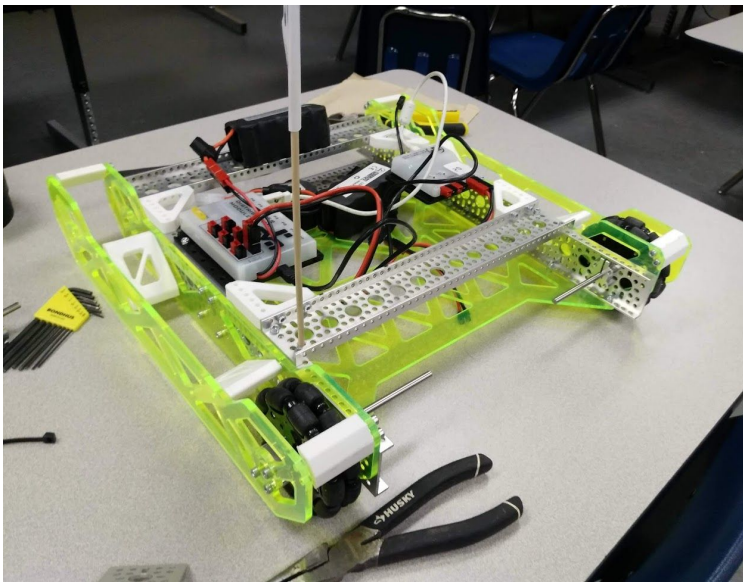
1. Buy and test more endmills
2. Improve workholding
3. Test more materials

Meeting #2

Authors: Matthew

OBJECTIVES:

1. **Repair Mecanum Chassis made for training**
2. **Put together parts list to order for prototyping**



PROGRESS:

- Mecanum Chassis Repair
  - One of the motors on the chassis was broken and we needed to use the chassis for prototyping
    - Took motors from another robot and put them on
    - Took time to manage cables
- Prototyping parts list
  - Decided on parts that we'd use to start prototyping intakes
    - VEX Flex wheels
    - Gobilda channels/axles/hubs
    - Extra servos
  - Added Parts needed to construct drivetrain to list
  - Added End Mills to list in order to machine different materials and hole sizes on our CNC

FUTURE PLANS:

1. Get parts ordered ASAP
2. Start constructing prototypes for intake
3. Start machining of drivetrain parts once endmills arrive

Meeting #3

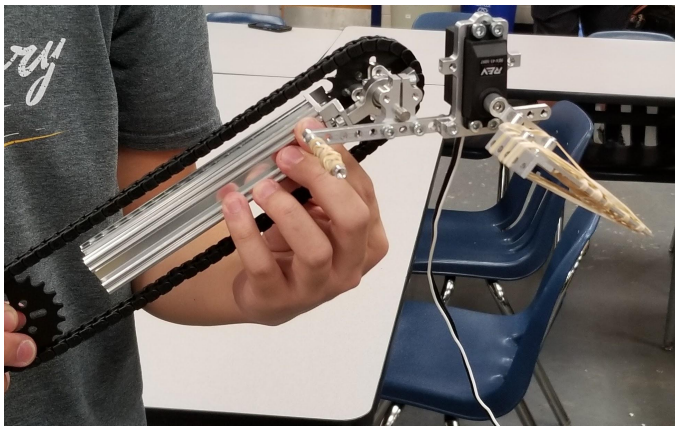
Authors: Andrew, Matthew

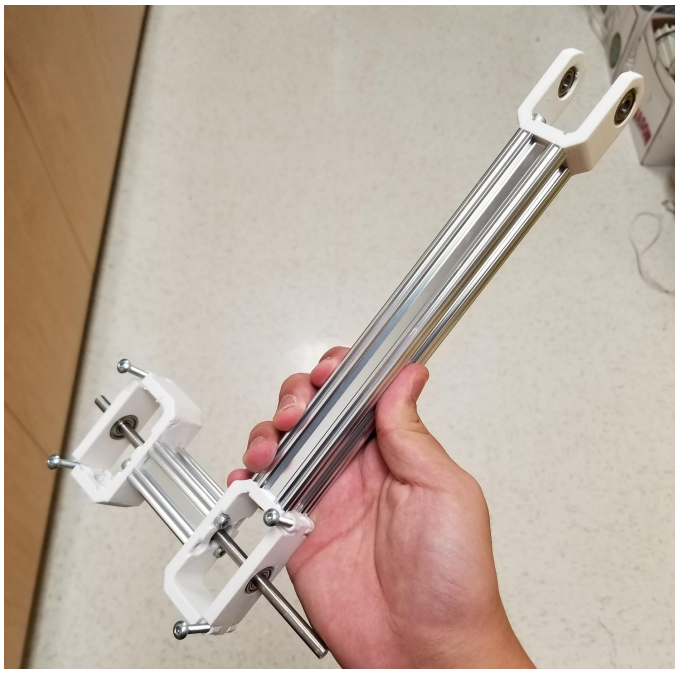
OBJECTIVES:

1. **Prototype chain bar**
2. **Prototype Gripper**
3. **CNC Wasteboard**

PROGRESS:

- Prototype chain bar
  - CAD Designed and 3-D printed parts to replace expensive + heavy goBilda pillow blocks
  - Assembled Z-shaped arm; waiting on right sized sprocket
- Prototype gripper
  - Began thinking of stud-gripping designs
  - Tested stud arm vs. stone face arm; which “appendage” should be attached to servo and which should be fixed
  - Ultimately chose fixed stud gripper and moving face gripper for superior reliability
  - Metal “overhang” resulted in better rubber band grip
- CNC Wasteboard
  - Need consistent work holding in order to machine parts
  - Put threaded inserts into wasteboard to allow clamps to be used/parts screwed down





FUTURE PLANS:

1. Get parts ordered ASAP
2. Start constructing prototypes for intake
3. Order sprockets for chain bar
4. Continue testing gripper

Meeting #4

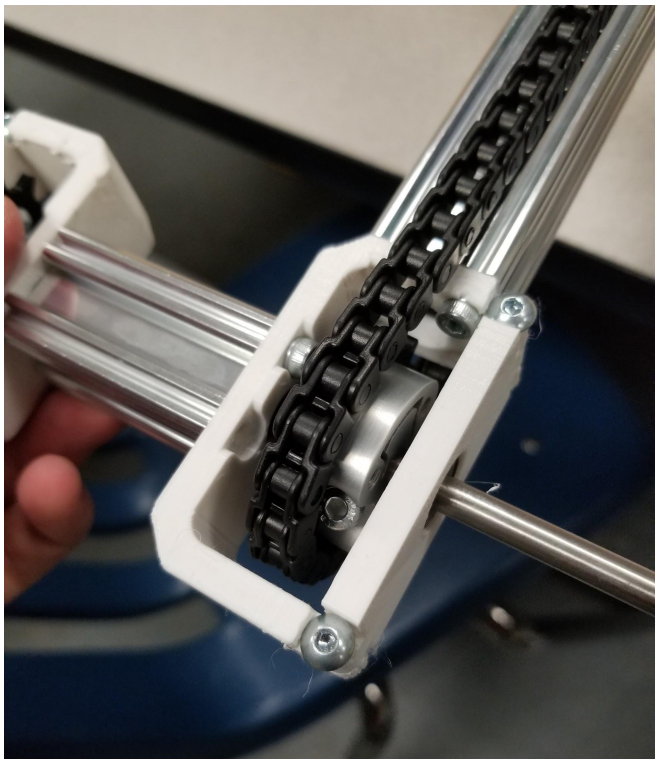
Authors: Andrew

OBJECTIVES:

1. **Test Gripper**
2. **Test Chain Bar**
3. **Prototype Intake**
4. **Finish Wasteboard Inserts**
5. **Begin Manufacturing Drivetrain Parts**

PROGRESS:

- Chain bar implementation
  - Smaller sprockets arrived, we installed them in the 3-D printed parts and assembled the through-gorail section
  - Works as designed/intended
- Gripper Improvement
  - Gripper was skewed and loose gripping
  - Added sidebars to secure stud, unskewed the face gripper by moving it closer to the servo
  - Mounted grabber onto chain bar, verified it clears the bar
  - Reprogrammed servo to yield a tighter hold
- Evaluate intake wheels
  - Rubber WCP wheels arrived
  - GoTube inserts had a great fit and lots of torque, but caused the wheels to become much too stiff
  - Original plan of soft TPU 3-D printed hubs will be resumed



FUTURE PLANS:

1. Design and CAD proper compliant gripper
2. Start constructing prototypes for intake
3. Determine appropriate chain bar lengths
4. Decide on motor and shaft mounting for chain bar

Meeting #5

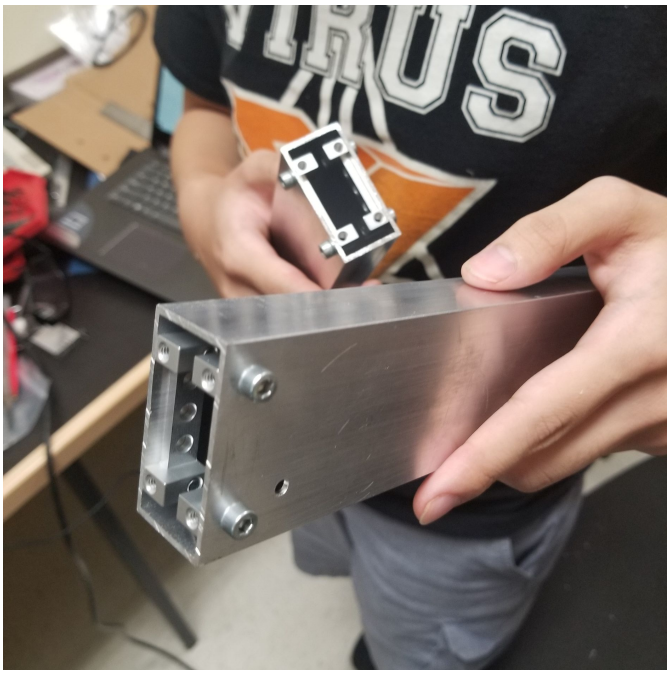
Authors: Andrew, Matthew

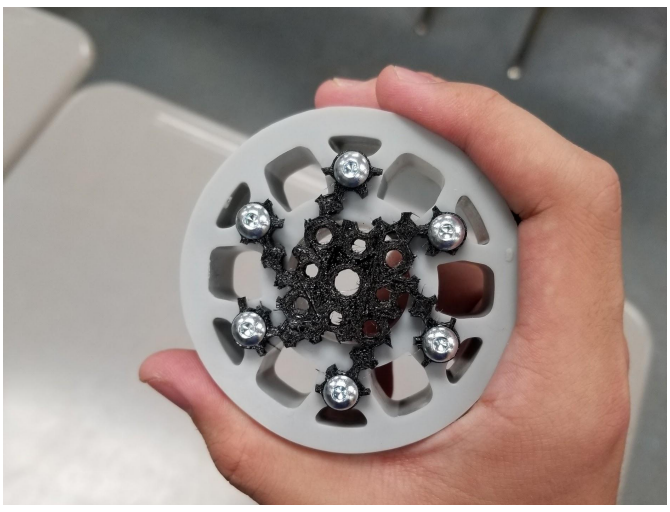
OBJECTIVES:

1. **Finish making box tube drivetrain beams**
2. **Start machining side plates**
3. **Evaluate intake wheel hubs**

PROGRESS:

- Box Tube Beams
  - Cut remaining pieces of box tubing out
  - Used a file to flatten and flush the ends
  - Used a 3D-printed jig to drill precise holes into the box tube
- Side Plate Machining
  - Tried to cut outer side plate out of ⅛” polycarbonate
  - Broke an endmill, ended up running the cutter slower and fixed depth of cut issues
  - Played around with workholding some more
    - settled on using double sided tape and screws
    - Contour operation left tabs to be manually cut out next meeting
- Intake wheels
  - Hexagon-patterned 3D-printed TPU design proved FAR too stiff, did not have any give
  - Slicing out nearly all the material, leaving six flexible spokes
  - Wheels are still barely stiffer than preferred, new arch-spoked or thin hexagon designs considered





FUTURE PLANS:

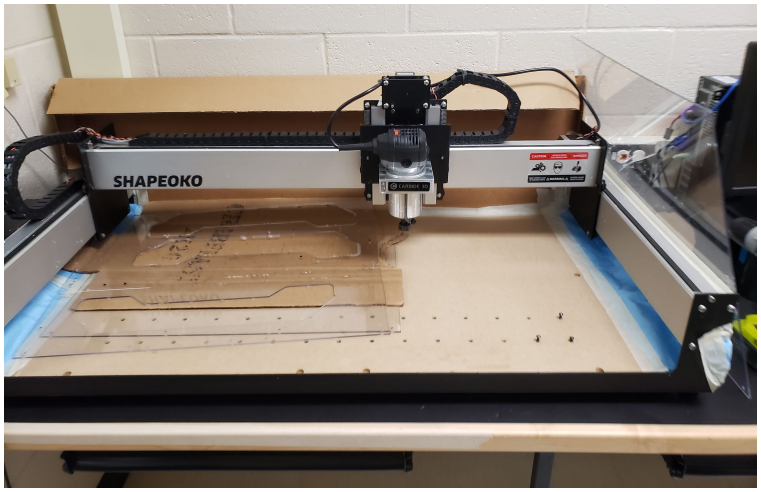
1. Continue to machine side plates
2. Finish cutting side plate out
3. Design and print new wheel hubs
4. Install threaded inserts onto CNC

Meeting #6

Authors: Curtis, Matthew

OBJECTIVES:

1. **Print updated intake wheel hubs**
2. **Cut and deburr extra side plates**
3. **Enclosure for CNC**



PROGRESS:

- Cut an outer side plate
    - Will be used for construction during tomorrow's meeting
- Removed outer side plate from the stock
    - Cut off tabs and sanded them down using the belt sander
    - Drilled out pilot holes using hand drill
- Temporary dust protection for CNC
    - Cutting the side plates created many plastic chips and they got everywhere
    - We wanted to enclose the CNC to keep the space clean and make clean-up easier
    - Constructed enclosure out of cardboard, tape, and paper
- Printed new intake hubs out of TPU
    - New hubs are significantly more polished
    - 6-spoked design works well and has a low profile

FUTURE PLANS:

1. Design clamps for more reliable CNC workholding
2. Continue prototyping intake

Meeting #7

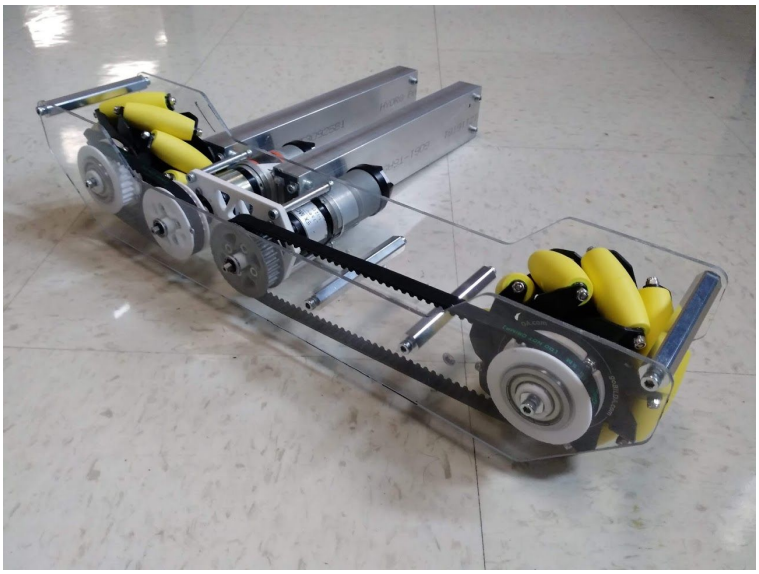
Authors: Curtis, Matthew

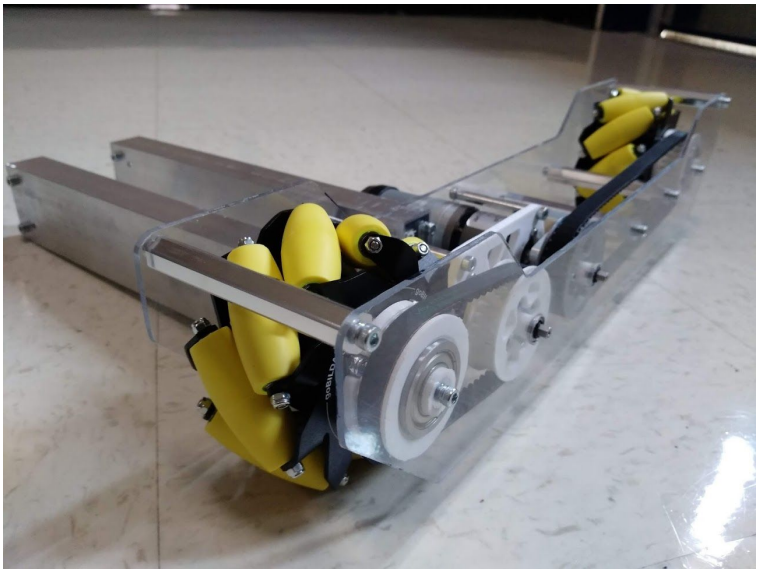
OBJECTIVES:

1. **Cut more side plates**
2. **Start Assembling drivetrain**
3. **Develop CAM for intake plates**

PROGRESS:

- Put together a drivetrain pod to test various factors like belt tension, rigidity, etc
    - Belts are rather tense, but not too taut: there is almost no backlash between the motor and the wheel
    - Polycarbonate plates initially felt too flimsy, but once building was complete, each drivetrain pod was surprisingly rigid
    - The box tube attaches nicely
        - some flex laterally due to flimsy polycarbonate plates, but nearly no flex vertically
- Created CAM toolpath for prototype intake plates
    - Did not get a chance to machine, too busy machining side plates.
    - Still getting acclimated to CNC





FUTURE PLANS:

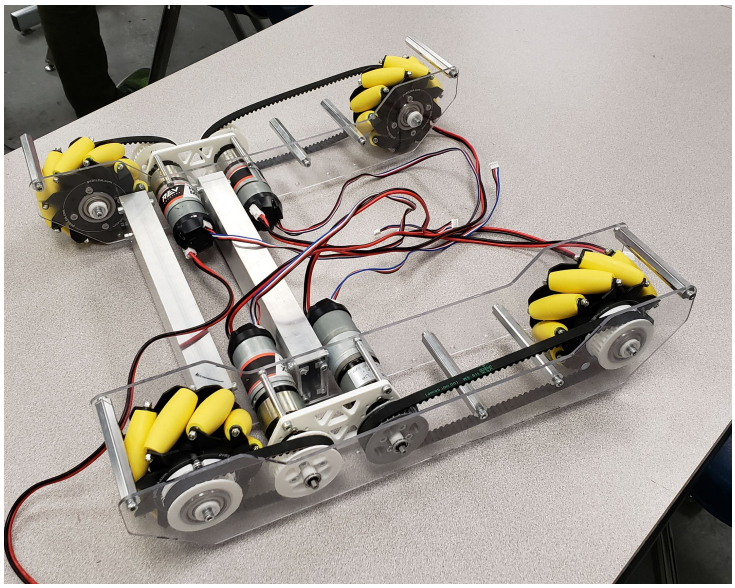
1. Finish assembling drivetrain
2. Machine intake plates

Meeting #8

Authors: Curtis, Matthew

OBJECTIVES:

1. **Continue to put together drivetrain**
2. **Continue to cut drivetrain plates**
3. **Repair VIRUS Rover Ruckus robot**



PROGRESS:

- Began building second half of drivetrain
    - Built as much as we could without the outer side plate machined
    - Small amount of flex near the front of the chassis, where there is the least amount of structural support
        - Should be minimized with the thicker delrin plates we plan to use later
- Spent time ordering parts for the robot
    - Placed orders for linear slides, new tools, motors, and other miscellaneous hardware
- Spent time getting last year's robot functional in order to use it for outreach
    - Repaired intake, slides, and broken phone holder

FUTURE PLANS:

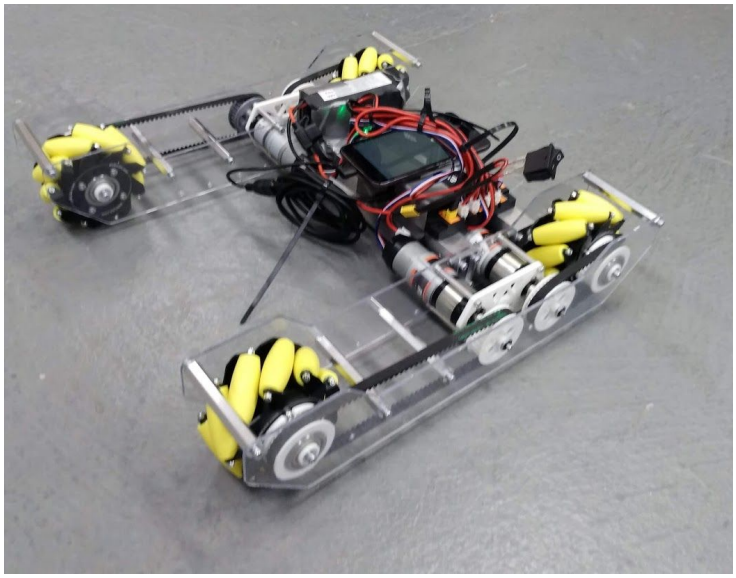
1. Finish assembling and wiring drivetrain
2. CNC prototype intake

Meeting #9

Authors: Curtis, Matthew

OBJECTIVES:

1. **Cut last drivetrain sideplate**
2. **Assemble and wire drivetrain**



PROGRESS:

- Machined the very last side plate
  - Once again, held down using screws and double sided tape
  - Used router to make pilot holes which we drilled out using a hand-drill
- Attached last side plate
  - Wired up electronics and battery
  - Slight amount of flex in the front of the robot
    - Plans to add belly pan if thicker plates aren't enough support
  - Temporary plates rigid enough for testing code
  - Temporarily affixed robot phone, REV hub, and battery to the rear box tube

FUTURE PLANS:

1. Finalize CAD so that we can finalize drivetrain
2. Get belly pan cut
3. Get parts ordered to start assembling odometry

Meeting #10

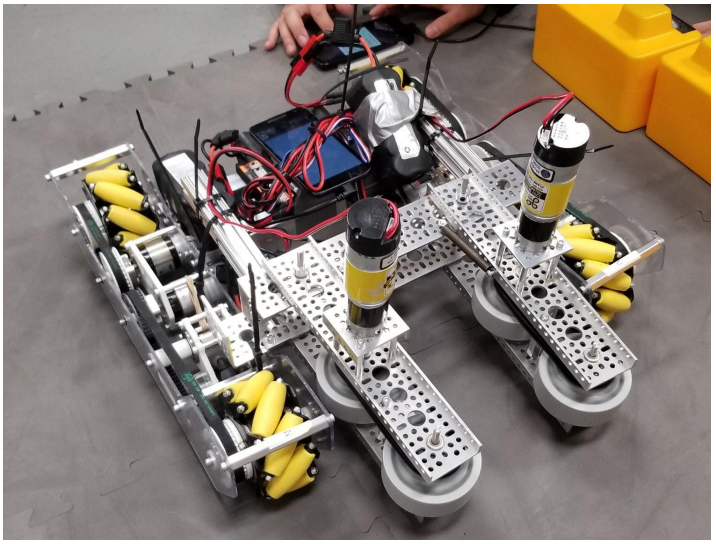
Authors: Eric, Matthew, Andrew

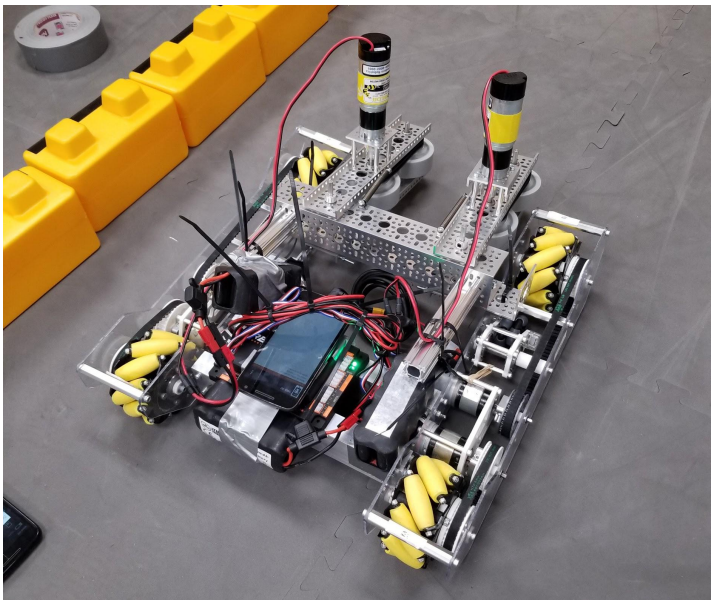
OBJECTIVES:

1. **Assembled odometry pod**
2. **Assembled intake prototype**
3. **Assembled slides prototype**

PROGRESS:

- Odometry installed in one drivetrain pod
  - Assembled an odometry pod and placed it inside our drivetrain
  - Pod rotates well and springs well using a rubber band
  - Were not able to test because we did not have the proper cable
  - Odometry pods required us to adapt a ribbon cable to 2.0mm JST
- Intake prototyped and installed (see next page for testing of the intake)
  - Motors not cantilevered (unstable design), instead coupled to the shaft
  - Found ideal angle for stones, but also a dead zone due to design flaw
  - Springs attached to pull intake inwards in order to collect stones
- Slides coupled to each other
  - Assembled a 3-stage slide using prototype inserts
  - Slides worked well, no real issues





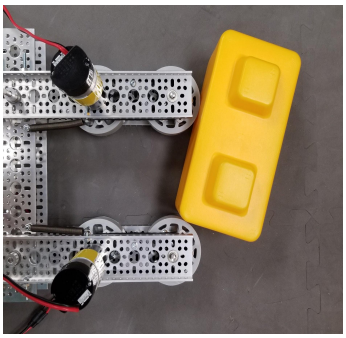
FUTURE PLANS:

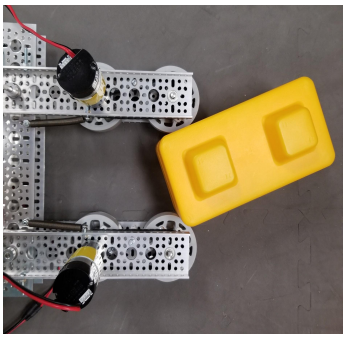
1. Continue assembling more odometry
2. Print new slides inserts and install
3. Stabilize the intake wheels
4. Design and prototype a swiveling mechanism for intake

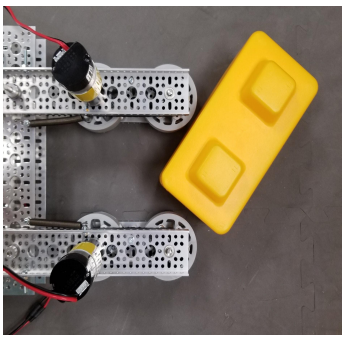
Intake Test Results

Authors: Eric

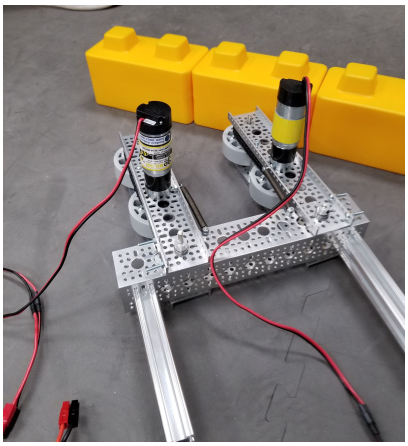
DETAILED EXPLANATION:

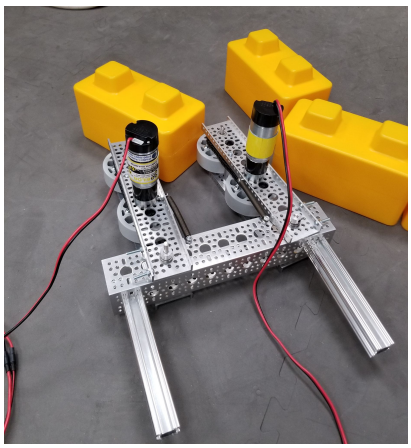






- Cantilevered motors unstable
  - Intake wheel would not be centered, unbalanced spinning and shaking
  - Solved by raising motor to couple it to a shaft held by two channels
- Intake flaws
  - Particular wheel is not secure to axle, might be hub problem
  - Channel on intake pushes the stones at certain area
  - Flexible adapters too flexible, found in unusual positions and makes intake unstable





- Intake behavior
  - Cannot intake stone horizontally
    - Stalls the motors and jams the intake
  - Springs securely intake stones, apply squeezing pressure
    - Easy to take from above
  - Tends to push nearby stones everywhere, disorganized
    - Could interfere with alliances in autonomous
    - Can be fixed with a shroud on the outside of intake

Meeting #11

Authors: Matthew

OBJECTIVES:

Assemble and wire Odometry

PROGRESS:

- Put together the remaining odometry pods
    - Assembled the 3D-printed parts
    - Verified that the distance from the magnet to the sensor was good by powering the encoders with alligator clips

- Had to cut and solder the cables to interface with rev hub cables
    - Initially improperly wired to 3.3v
    - changed wiring to 5v
    - All powered via the Rev hub's 5v power headers via a custom splitter

FUTURE PLANS:

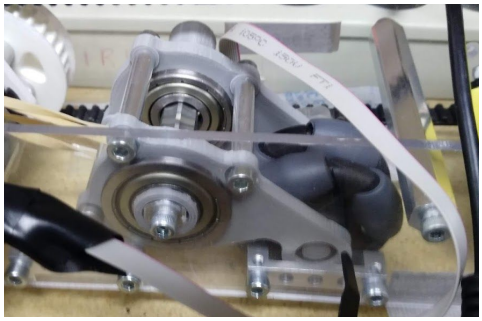
Install Odometry pods onto the robot chassis

Meeting #12

Authors: Matthew

OBJECTIVES:

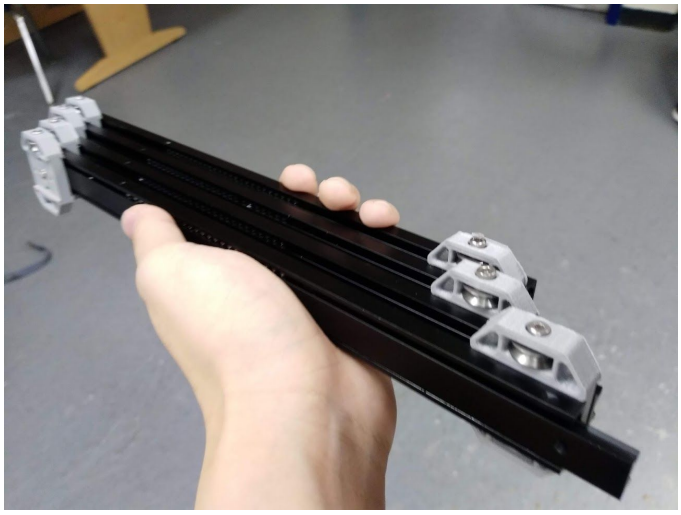
1. **Install Odometry**
2. **Test new Slide inserts**



PROGRESS:

- Odometry
    - Installed odometry
        - Mounted the forwards odometry on their mounts
        - Drilled and tapped hole in box tube for side odometry
        - Springing and end limits worked fine
        - Forwards odometry may need more clearance, comes close to contacting drivetrain

- Slides
    - New Inserts work well
    - Inserts leave room for string but prevent string from easily jumping off pulley
    - Ball bearing pulleys run smoothly in insert



FUTURE PLANS:

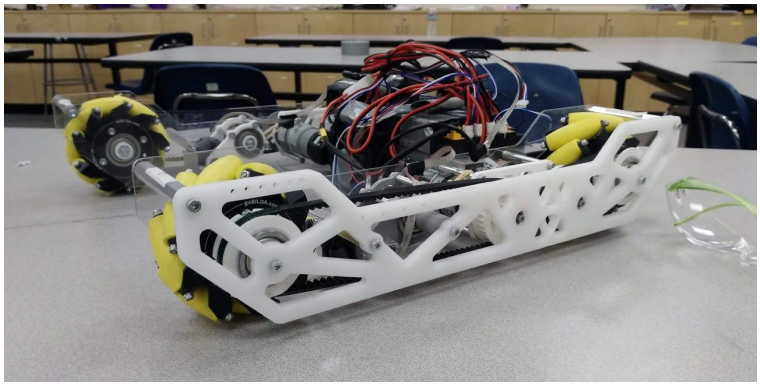
1. Machine new Delrin sideplates
2. Assemble slides onto full robot once ready

Meeting #13

Authors: Matthew, Curtis

OBJECTIVES:

1. **CNC Outer Sideplate**
2. **Prototype Grabber 2**



PROGRESS:

- Started cutting updated side plates out of delrin
  - New plates are up to date with CAD
  - Cut out of final material
  - Will allow us to go ahead with the final robot assembly
  - Started machining, and assembled onto robot at end of meeting
- The paper enclosure for the CNC we have been using as a temporary solution does not hold up to vacuuming
  - It holds chips well but does not handle stress.
  - Will need to be replaced with a better solution
- Attached first new side plate, began to cut the second

FUTURE PLANS:

1. Continue to cut remaining plates
2. Devise better CNC enclosure

Meeting #14

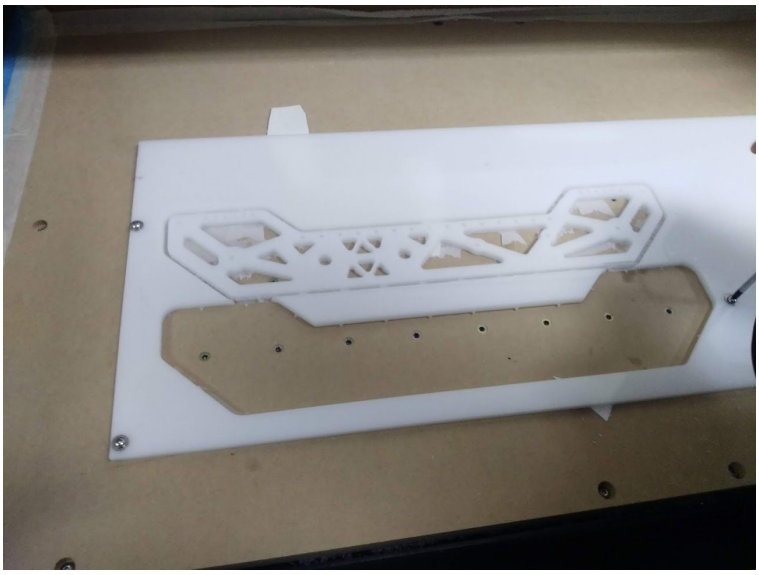
Authors: Matthew

OBJECTIVES:

1. **CNC 2nd Side Plate**
2. **Continue 3D printing parts for slides**

PROGRESS:

- Machined the 2nd outer side plate
    - Had an issue in the middle of machining pockets, z axis bottomed out and lost rigidity
    - Finish affected, attempted to drill out holes by hand for bearings but they were still off center
    - Will use, but might recut later
- 3D print slides parts
    - Continued to print parts so we can prototype slides
    - Printed spool and additional inserts



FUTURE PLANS:

1. Assemble and prototype slides
2. Continue CNC'ing side plates

Meeting #15

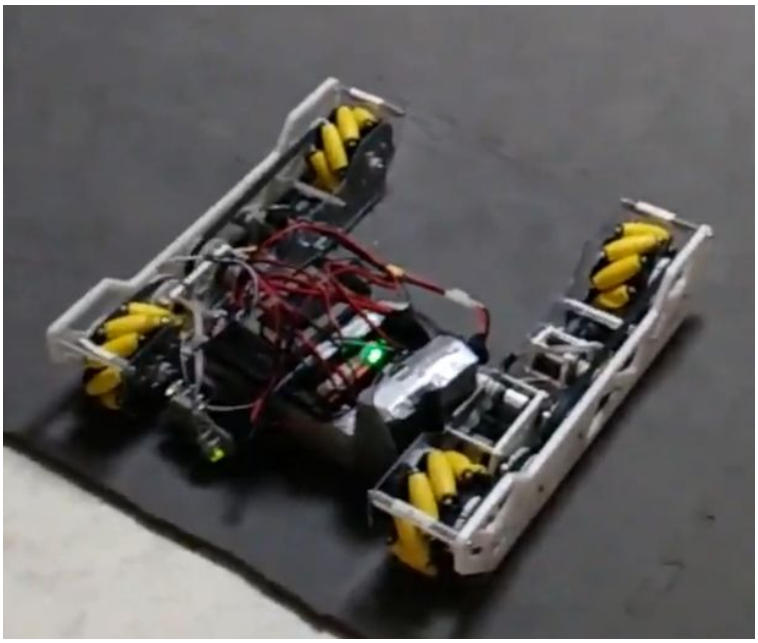
Authors: Matthew, Andrew

OBJECTIVES:

1. **Install 2nd side plate**
2. **Test slides with motor**
3. **CAD/prototype custom intake designs**

PROGRESS:

- Install 2nd side plate
    - Took off prototype polycarbonate side plates, attached new side plate
    - Could not put in bearings for motors due to off center holes, still worked alright
- Slides Testing
    - Strung up slides and used a spare motor to test
    - Slides went up quickly and had plenty of torque



FUTURE PLANS:

1. Machine inner side plates
2. Print parts for intake

Meeting #16

Authors: Matthew

OBJECTIVES:

1. **Machine Inner Side Plate**
2. **3D printing parts**

PROGRESS:

- 3D printed intake parts
  - Mounts for attaching to robot
  - Plates
- 3D printed slide parts
  - Prototype slide mounting pieces
  - Roller pieces for string
- Machining first inner side plates
  - Machined first inner side plate
  - Had issue where CNC shifted in X axis between pocket and contour operations
  - Part still functional, but will replace later

FUTURE PLANS:

1. Finish machining inner side plates
2. Design enclosure for CNC

Meeting #17

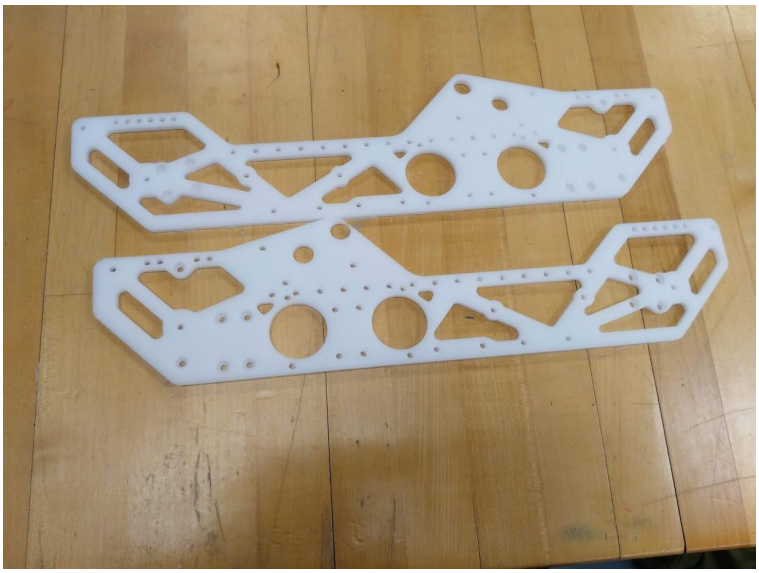
Authors: Matthew

OBJECTIVES:

1. **Finish Machining Inner Side Plates**
2. **Create new CNC enclosure**

PROGRESS:

- Clean up first side plate
- Machined Last Inner Side Plate
    - Experimented with plunging deeper into the stock (⅛”)
        - Seemed to cut fine
    - Had an issue when cutting the holes
        - Broke the 2mm endmill, possibly because of material clogging it



- Cardboard CNC Enclosure
    - Paper enclosure was hard to vacuum from
    - Replaced with cardboard enclosure
    - Included flaps for material that sticks outside of the machine

FUTURE PLANS:

1. Install inner side plates
2. Assemble intake

Meeting #18

Authors: Matthew

OBJECTIVES:

1. **Install Side Plates**
2. **Construct rollers for slides**

PROGRESS:

- Installed new side plates
    - Required most of the robot to be taken apart
    - New side plates gave the drivetrain much more rigidity
    - Also installed intake mounting modules to prepare for intake assembly and mounting
- Constructed slide rollers
    - Assembled 3D printed ball bearing rollers for linear slide assembly
    - Used in order to keep string bends at 90 degrees to eliminate axial loads

FUTURE PLANS:

1. Update Odometry Modules
2. Assemble intake

Meeting #19

Authors: Matthew

OBJECTIVES:

1. **Upgrade Odometry**
2. **Fix Wheels**
3. **Start Assembly of Intake**

PROGRESS:

- Upgrade Odometry
  - Had issue previously with odometry hitting a beam on the drivetrain
    - Replaced with smaller more compact odometry
  - Previous wiring was messy
    - Resoldered and reinsulated custom length cables
- Fix Wheels
  - We noticed we assembled the wheels incorrectly and reassembled them in the correct orientation
- Intake Assembly
  - We started to put together part of the intake, eventually having one half done by the end of the meeting.

FUTURE PLANS:

Finish assembling intake

Meeting #20

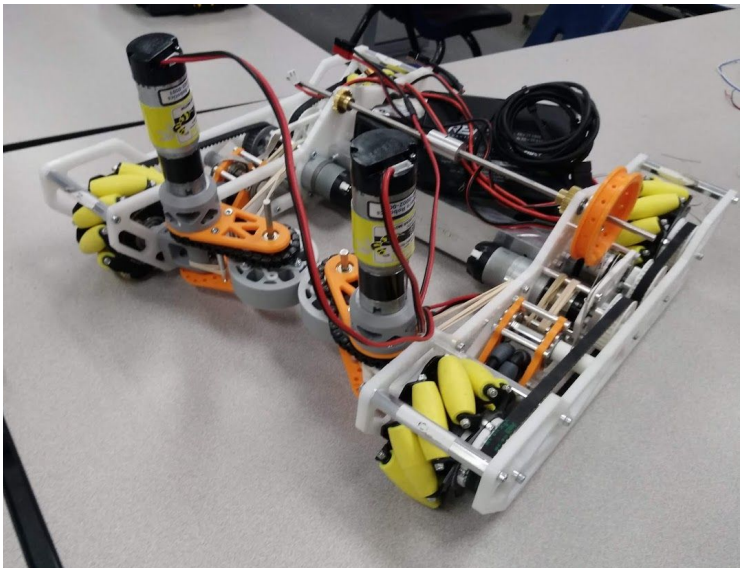
Authors: Curtis

OBJECTIVES:

1. **Assemble intake**
2. **Test intake with skystones**

PROGRESS:

- Intake Assembly
    - Assembled the other half of the intake and mounted it to the motor.
- Intake Testing
    - Deployment works very well
        - Deploys by folding intake halves against each other and running wheels
    - Worked very well for narrow angles
    - When block came in sideways, intake would sometimes jam
    - Some minor issues with chain tension and strength of the clamping coupler



FUTURE PLANS:

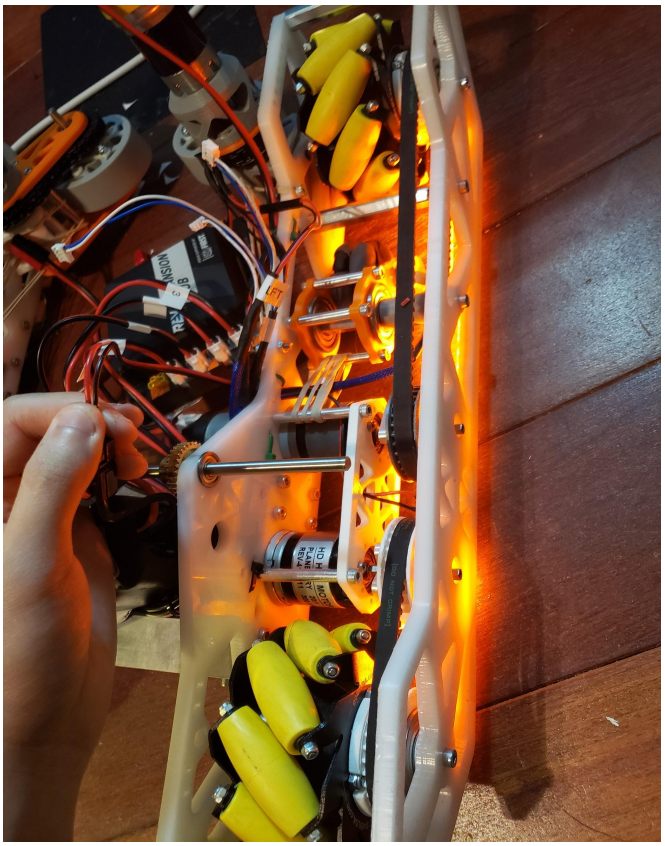
Improve intake design

Meeting #21

Authors: Curtis

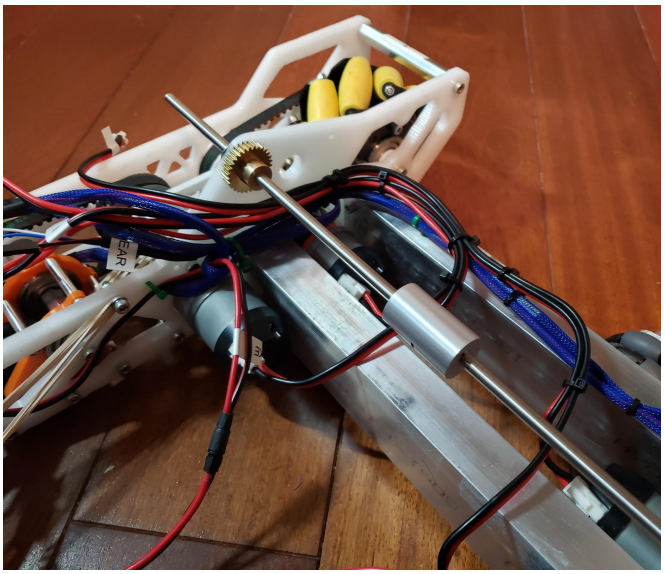
OBJECTIVES:

1. **Sleeved Cable**
2. **Managed and routed cable**
3. **RGB**



PROGRESS:

- Sleeved the custom cables we made a few meetings ago
    - Used plastic cable sleeving
    - Protects cable from being pinched or getting tangled
- Routed cables to planned location of REV hub
- Labeled all cables for easy organization
- Experimented with LED lighting to improve aesthetics
    - Mounted orange LEDs to one of our outer side plates
    - It looks sick



FUTURE PLANS:

1. Mount REV hub
2. Mount linear slides
3. Continue developing chain bar

Meeting #22

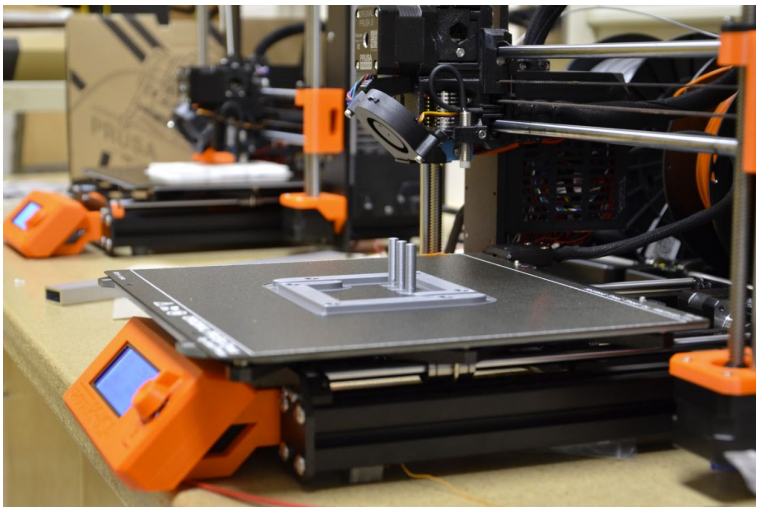
Authors: Matthew

OBJECTIVES:

1. **Repair 3D-Printer**
2. **Retensione intake rubber bands**
3. **Assemble Slides**

PROGRESS:

- Repair 3D-Printer
    - Lubricated 3D-printer bearings because x-axis was not smooth
- Retensioning Intake
    - Intake springing was too loose
    - Retensioned so that the springing was stiffer
    - Tested and found that it helped with picking up some blocks
- Assemble Slides
    - Put together the right half of the slides and attached it to the robot



FUTURE PLANS:

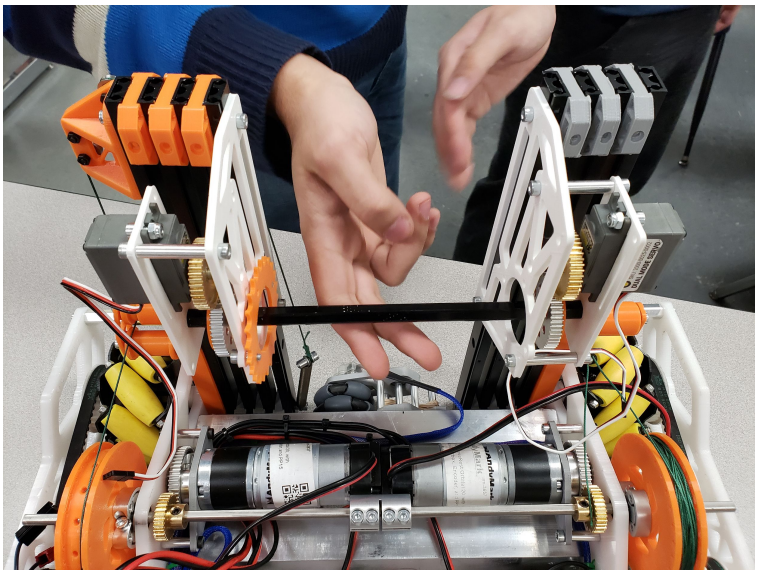
Finish assembling and attach the other half of the slides

Meeting #23

Authors: Matthew, Eric

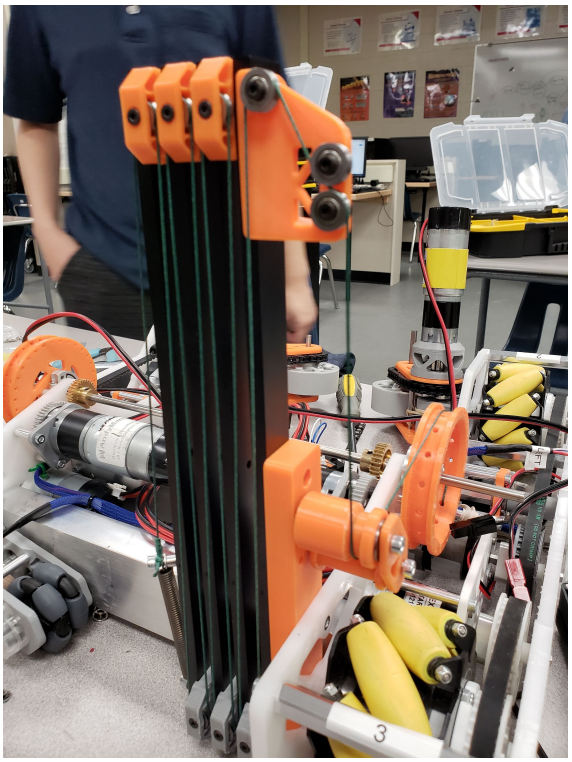
OBJECTIVES:

1. **Complete attaching slides to robot**
2. **Assemble chain bar**
3. **Cut prototype chain bar plates**



PROGRESS:

- Assembling slides
  - Built slides for the left side and attached them
  - Strung up the slides to for extension
- Chain bar
  - Assembled the mounting plates and servos for the chain bar
  - Tapped and cut a hex axle to length
  - One plate was cut from wood by the CNC
  - Chain bar will be used to maneuver stones after intaking them



FUTURE PLANS:

1. String slides for retraction
2. Test slide extension/retraction with motors
3. Recut chain bar plates out of delrin

Meeting #24

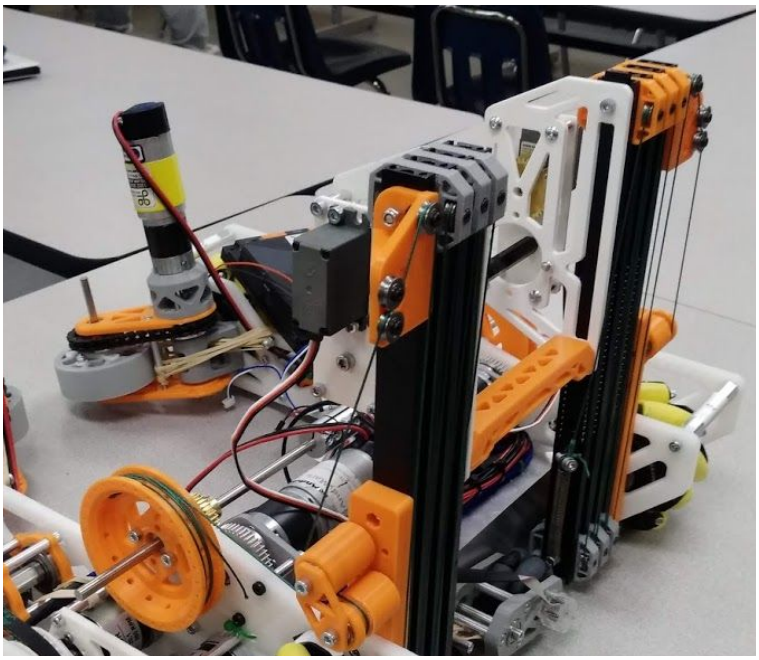
Authors: Matthew

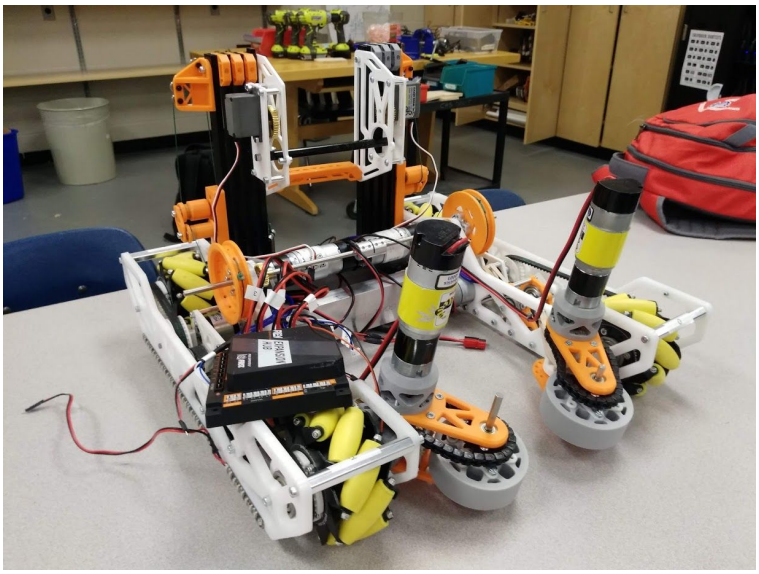
OBJECTIVES:

1. **Finish stringing slides**
2. **Test with motors powered**
3. **Attach Crossbar**

PROGRESS:

- String Slides
  - Strung slides for retraction
- Test Slides
  - Connected 2 motors in serial and plugged into a battery
  - Slides raise quickly with enough torque, go up and down well
- Attach Crossbar
  - Keeps the two sides of the slides coplanar
  - Keeps chain bar assembly rigid





FUTURE PLANS:

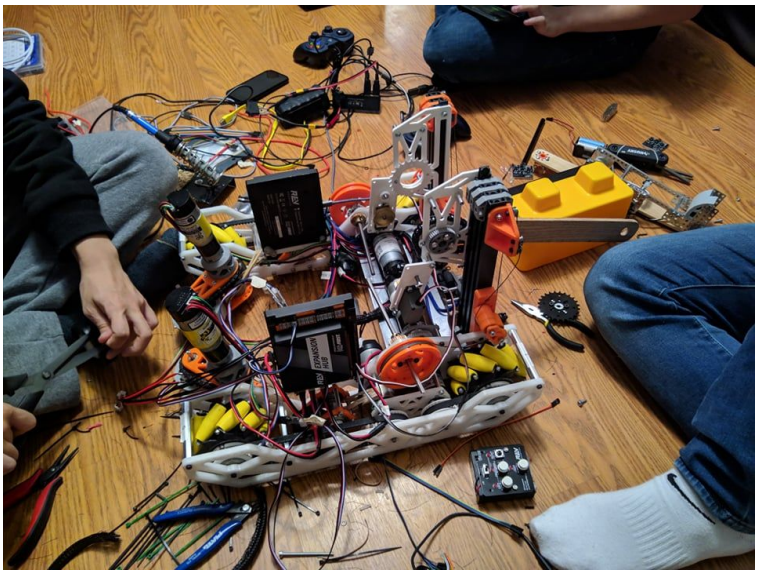
1. Attach Rev Hubs
2. Further develop chain bar arm

Meeting #25

Authors: Matthew, Curtis

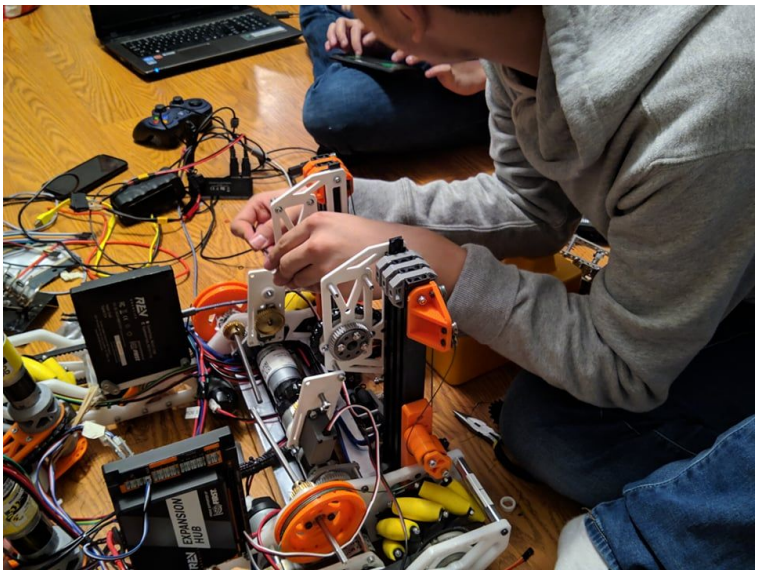
OBJECTIVES:

1. **Attach REV hubs**
2. **Attach prototype chain bar**
3. **Manage cables**



PROGRESS:

- Attached REV hubs to robot
    - Managed configuration with programmers
- Chain bar prototype is mounted
    - Second arm plate had to be cut by hand
        - Dimensions not as accurate
        - Poor screw tolerances
    - Slightly loose assembly, but usable for testing
    - Chain bar servos tested



FUTURE PLANS:

1. Design and print guides for intake
    a. Stones have too much space to move after intake
    b. Guides will make it easier for chain bar to pick up stones
2. Recut the chain bar plates out of delrin on the CNC

Meeting #26

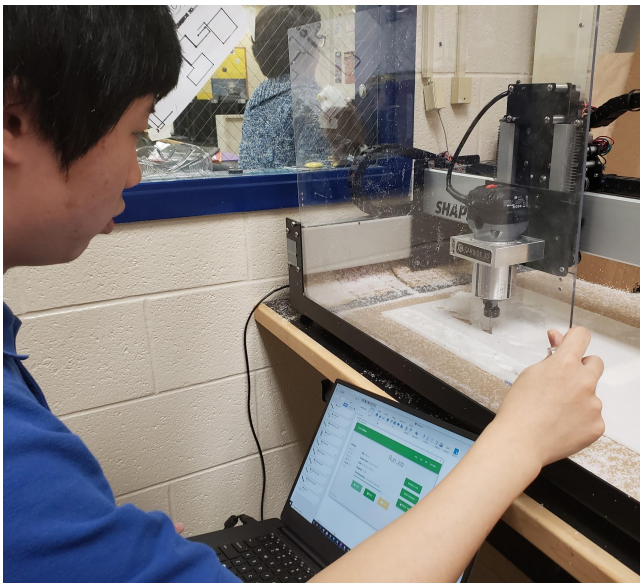
Authors: Matthew, Keertik, Curtis

OBJECTIVES:

1. **Machine new chain bar arms**
2. **Start Foundation Dragger Construction**

PROGRESS:

- Machine Chain Bar Plates
    - First plate machined extremely poorly
    - After troubleshooting, we replaced the endmill and recut
- Assembled foundation dragger modules
    - Attached dragger pieces, sprocket to axle using hubs
    - Assembled servo block and attached sprocket



FUTURE PLANS:

Mount/chain foundation dragger

Meeting #27

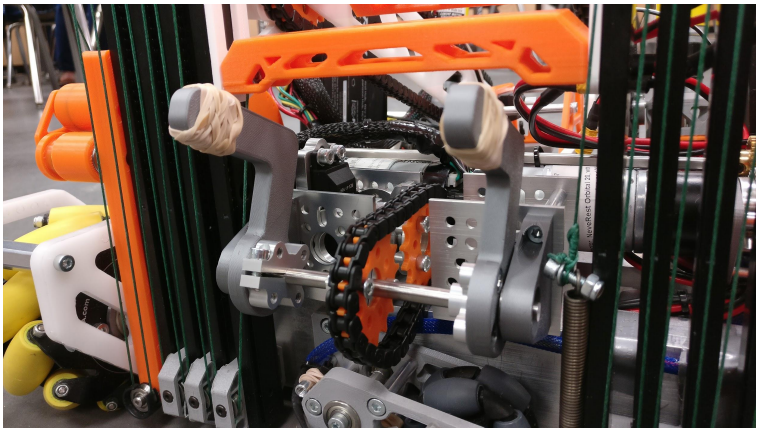
Authors: Keertik, Andrew

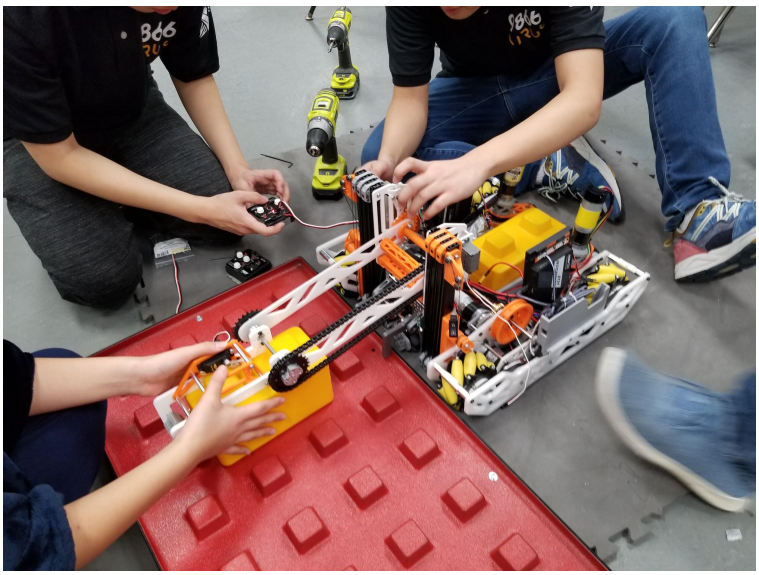
OBJECTIVES:

1. **Construct Chain Bar**
2. **Construct Grabber**
3. **Finish Foundation Dragger**

PROGRESS:

- Mounted foundation dragger
  - Could only attach servo-side c-channel at one point
    - Servo block interfered with screws
  - Attached the servo and axle modules onto the mounting hardware and chained up the mechanism
  - Rubber banded bottom of foundation dragger arms for grip
  - Servo side worked itself loose
- Mounted chain bar
  - Greatly improved reliability with new 3D printed spacers and parts
  - Drilled out 3D printed parts to use bushings without the need for bearings
  - Programmed servos
- Mounted chain bar-mounted grabber
  - Installed pieces of wheels for the grabber's contact points
  - Aligned plastic sprockets and chain bar to be horizontal
  - Planning to remove standoffs to allow intaking in rest position





FUTURE PLANS:

1. Create another hole into the box tube to better mount servo-side c-channel
2. Tele-op test the arm and grabber

Meeting #28

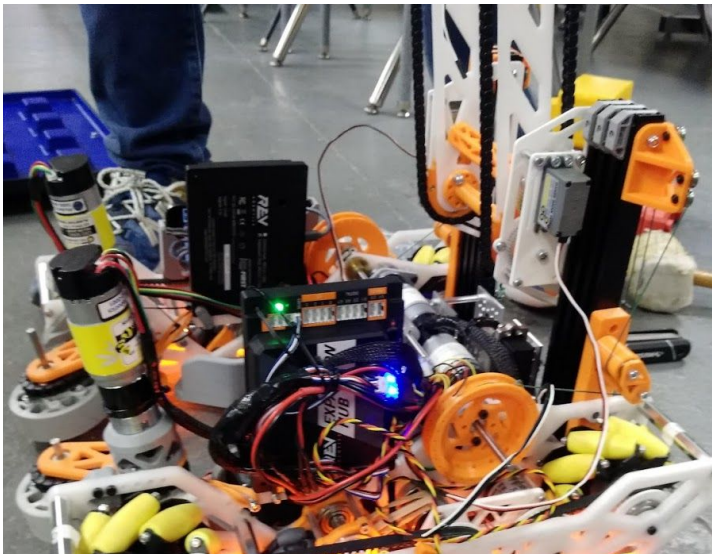
Authors: Matthew, Eric

OBJECTIVES:

1. **Adjust wiring**
2. **Reinstall foundation grabber**
3. **Test chain bar**

PROGRESS:

- Further wire management
    - Intake was shutting on and off
        - Connectors within the cable bundle had disconnected
        - Reattached and electrical taped intake cables
    - Chain bar cables connected and routed temporarily
        - Servo extension cables to REV hubs do not provide enough range
        - Will need to be replaced with a more permanent solution



- Reinstall foundation grabber
    - Re-drilled and tapped new holes on aluminum bar
    - Rebuilt the grabber
- Test chain bar
    - Rewiring and running chain bar

FUTURE PLANS:

1. Figure out how to manage cables so they can extend over ~4 feet but remain compact when slides are lowered
2. Mount stone grabber to chain bar

Meeting #29

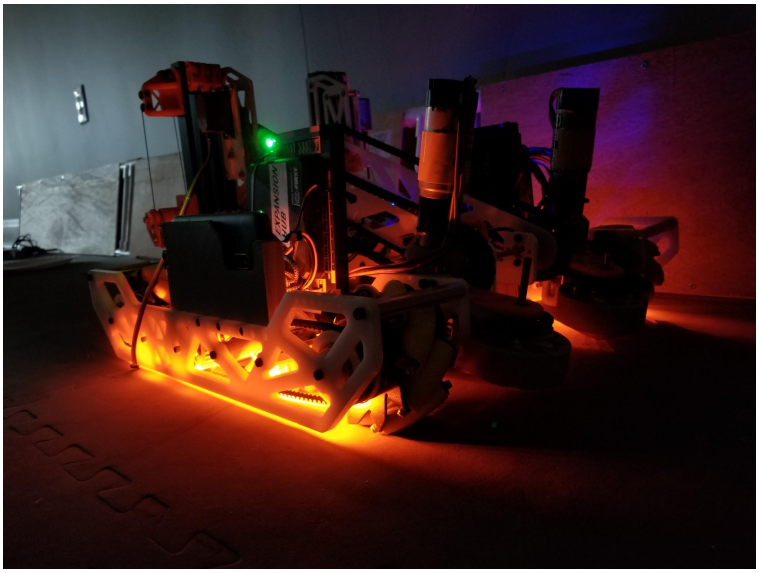
Authors: Andrew, Curtis

OBJECTIVES:

1. **Wire Up Arm and Gripper Servos**
2. **Test LED lighting**
3. **Reinforce Chain Bar**
4. **Program Teleop Components**

PROGRESS:

- Spiral cable
  - Used a custom coiled cable to route wires to the chain bar and grabber servos
    - Crimped pins onto the cable
    - Tested continuity
    - 12 conductor coil made 4 sets of 3-pin servo cables
    - Extra set for future additions or modifications
- LED Lights
  - Reinstalled LED strips on both exterior side plates
- Reinforce chain bar
  - Chain bar had a large amount of undesirable horizontal flex
  - Ziptied carbon fiber rod along length
- Removed a gripper standoff for stone intaking in ground position
  - Optimized gripper is now much more consistent



FUTURE PLANS:

1. Print and assemble team numbers onto sideplates
2. Redesign crossbar for slides

Meeting #30

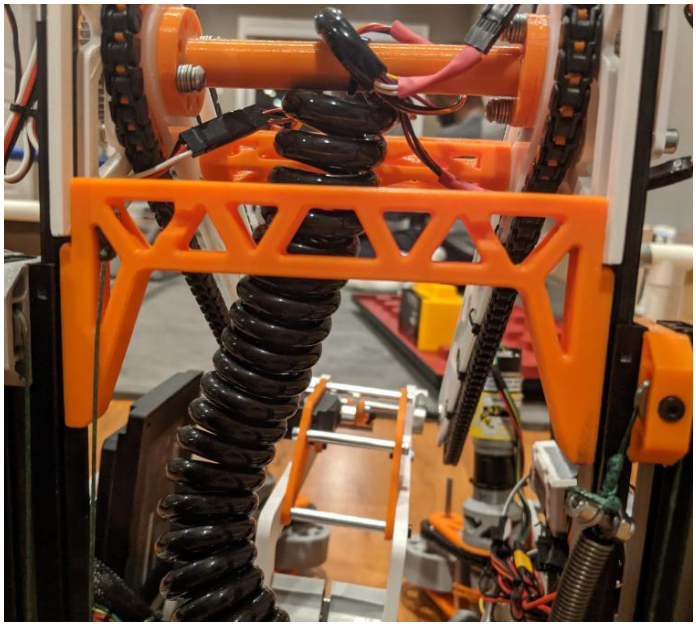
Authors: Curtis

OBJECTIVES:

1. **3D-print team numbers to go on side plates**
2. **Redesign the crossbar between our two slide assemblies**

PROGRESS:

- 3D printed our team numbers with cutouts to be press fit into the pockets in the robot's side plates
    - Reinforced connection with hot glue
- The previous crossbar only attached the slides via a single point
    - New design uses screw access holes on slides as additional mounting points
    - Makes the assembly significantly more rigid



FUTURE PLANS:

1. Test foundation dragger
2. Test autonomous
3. Practice driving

Meeting #31

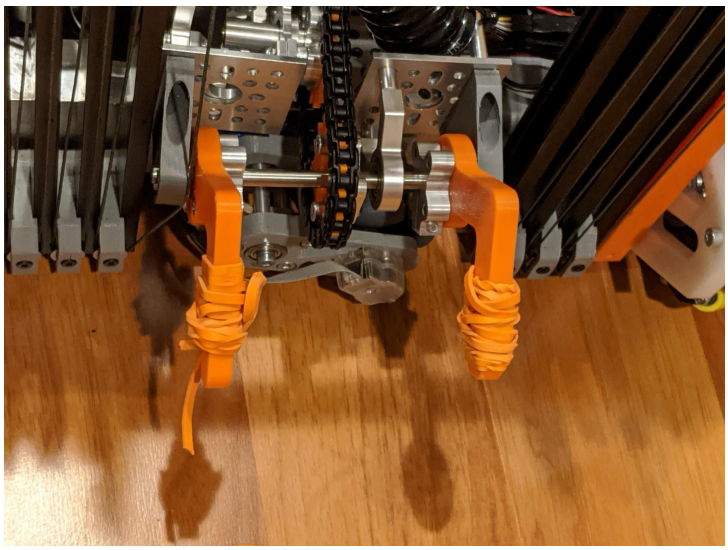
Authors: Curtis

OBJECTIVES:

1. **Figured out how to right fallen SkyStones**
2. **Sponsor plates**
3. **Testing foundation dragger**

PROGRESS:

- Cutting clear polycarbonate plates to display sponsors on the robot
    - General shape determined
    - Mounting holes drilled
    - Mounted on robot to assess fit
- Coiled rubber bands and compliant wheel chunks around foundation dragger increase grip
    - Experimented with incorporating chunks of compliant wheel
        - Grippiness of the rubber and the height of the dragger allows us to right stones by lowering the dragger onto the stone and driving backwards
- Rubber bands keep snapping during tests
    - More robust solution could be to dip the dragger into a 2-part silicone
    - Also considered embedding compliant wheel slices into part



FUTURE PLANS:

1. Prepare for qualifier
2. Refine notebooks and marketing materials
3. Practice driving
1. Display sponsors on sponsor plates
2. Figure out a more permanent method to implement a grippy dragger

Meeting #32

Authors: Curtis, Eric

OBJECTIVES:

1. **Reorganize wires**
2. **Driver tryouts**
3. **Foundation Dragging Testing**

PROGRESS:

- Used a power distribution module to distribute the power from the battery to the servo power module, LED strips, and both REV hubs
    - REV hubs alone did not have enough xt-30 headers
    - Managed related cables.
- Driver tryouts
    - Different drivers assessed for the amount of stones they can stack in 2 minutes
    - Drivers finalized
    - Team members familiarized with control scheme
    - Robot scoring is consistent, reliable
    - Continuous trials without failure
- Discussed mechanics of dragging foundation
    - Grabber inhibits movement when pushing
    - Should ideally only be used to turn or pull the foundation

FUTURE PLANS:

1. Pack/prepare for qualifier
2. Continue to test and develop autonomous paths
3. Practice driving

Qualifier 1

January 12th, 2020

Qualifier 1 Reflection

Authors: Curtis, Eric, Andrew

OBJECTIVES:

1. **Reflect on Sunday Qualifier**
2. **Brainstorm/Conceptualize Robot Hardware Improvements**
3. **Establish Timeline until Next Qualifier, States**

POSSIBLE IMPROVEMENTS:

- Chain bar servos do not have enough torque to reliably flip the grabber
    - Reduce length of chain bar
    - Reduce weight of grabber
- Reinforce linear slides
    - Current system utilizes 1-up, 1-down stringing system
        - Leads to crooked extension
        - Puts stress on slides
        - Only one side is supported while slides are extended
    - Replace 3D-printed adapter with metal box-tube
        - Added rigidity should help relieve stress
    - Implement 2-up, 1-down stringing system
        - Slides will be supported on both sides when extended, with an additional 3rd string to handle retraction
- Reinforce chassis to reduce sag
    - Drivetrain cantilevering outwards
- Incorporate capstone deposit mechanism

FUTURE PLANS:

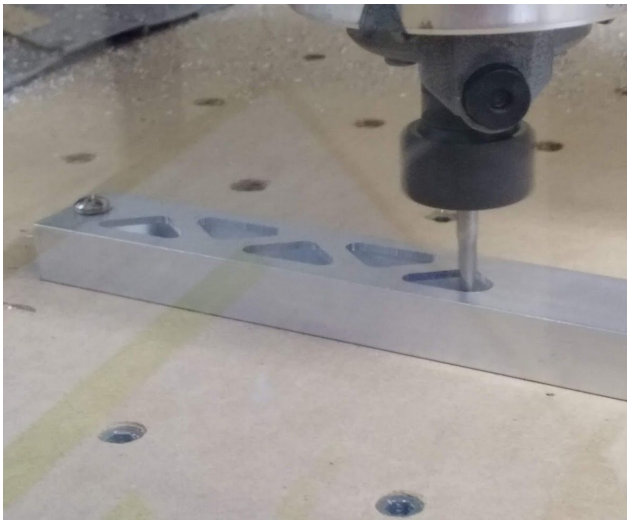
1. Revise Chain Bar design (focusing on lightness and torque)
2. Reinforce slides system and chassis
3. Redesign stringing system for slides
4. Incorporate capstone

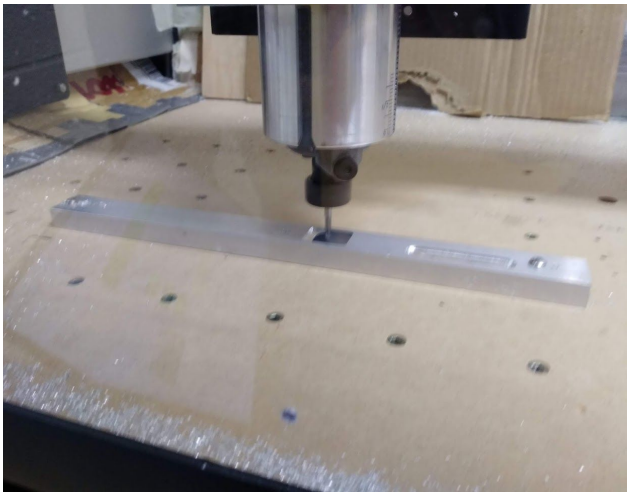
Meeting #33

Authors: Matthew

OBJECTIVES:

1. **Machine Slides Box Tube**





PROGRESS:

- Started Machining Box Tube for slides
  - Used to reinforce the back of the slides
  - Held stock using screws that were drilled into the box tube
  - Initially cut conservatively, used 4mm end mill to adaptive rough about 1.5 mm depth
  - Eventually determined that we could plunge the endmill the full 1/16” and still maintain a good finish
  - Flipped the tube over to machine both sides, zeroed to the center of the stock
  - After machining the 1st tube, cut the 2nd piece of stock but did not machine

FUTURE PLANS:

1. Finish Machining

Meeting #34

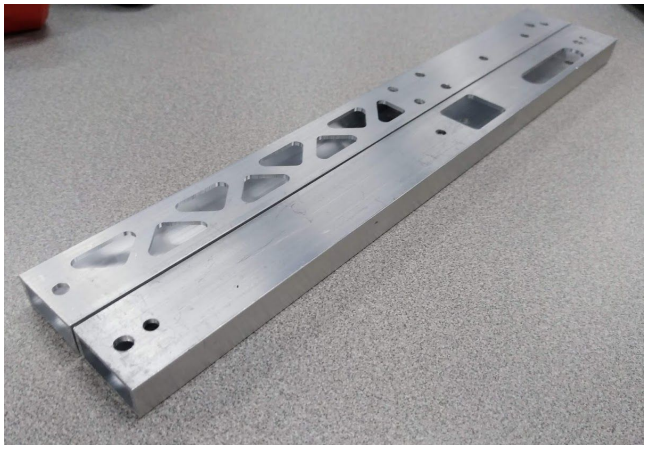
Authors: Matthew

OBJECTIVES:

1. **FInish Machining**
2. **Replace Servos**
3. **Start Re-Assembling Slides**

PROGRESS:

- Finish Machining
    - Developed CAM for a mirrored part and manufactured it
- Replace Servos
    - We ordered faster and stronger servos for our chain bar mechanism because our previous ones struggled a bit.
    - New ones seem to be torquier and smoother
- Re-Assemble Slides
    - Now that we have machined the aluminum, we wanted to attach it to the slides
    - By the end of the meeting, we had only finished half of the job.



FUTURE PLANS:

1. Finish slides rebuild
2. Continue to test and develop autonomous paths
3. Practice driving

Meeting #35

Authors: Matthew

OBJECTIVES:

1. **Finish Re-Assembling robot**
2. **Install Shapeoko Bitsetter**

PROGRESS:

- Re-Assemble Robot
  - Had taken much of it apart to replace slide structure
  - Finished replacing everything, and put it back together
  - Had to restring slides and pulleys
  - Aluminum backed slides seemed to help with bending, still a little bit
  - New intake had better tensioned chain, more responsive
- Install Shapeoko bitsetter
  - To improve our manufacturing workflow, we bought a tool length probe called the Bitsetter
  - Had to install, wire, and configure the tool before we could use it

FUTURE PLANS:

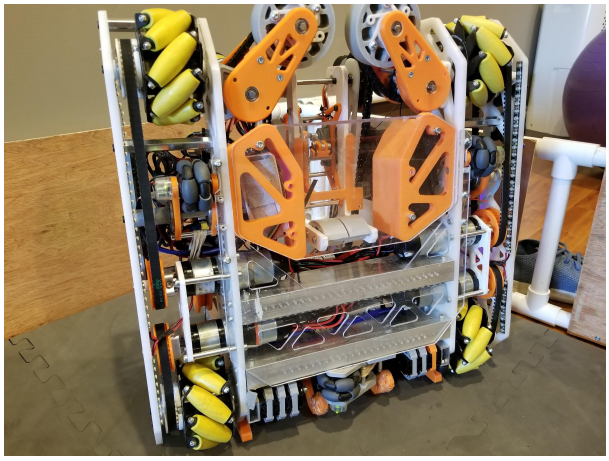
1. Practice Driving and evaluate bottlenecks
2. Test slides for reliability
3. Machine belly pan

Meeting #36

Authors: Matthew, Andrew

OBJECTIVES:

1. **Redo Intake**
2. **Machine Belly Pan**



PROGRESS:

- Intake Redesign
  - Redid the intake to solve some issues
  - Replaced motors with faster ones (from 13.7 to 5.2) because they would help us pick up stones faster
  - Made intake structure longer for more reach and accounted for chain tension so that the chain wouldn't be slack
- Machine Belly Pan
  - Machined structural belly pan out of polycarbonate
  - Attached to the bottom of the robot

FUTURE PLANS:

1. Practice driving
2. Machine Arm for chain bar

Meeting #37

Authors: Matthew, Eric

OBJECTIVES:

1. **Replace Grabber Servo**
2. **Machine Aluminum Arm**
3. **Prototype Scissor Extension Park**

PROGRESS:

- Replace Grabber Servo
  - We replaced the gripper servo with a higher torque servo to grip the stone better
- Machine Aluminum Arm
  - Replacing chain bar delrin arm with aluminum for rigidity
  - Pocketed out large sections to make sure the mechanism was light
  - Used the Shapeoko bitsetter to probe tool length for tool changes
- Prototype Scissor Park
  - Parking the whole robot can be hectic and pressuring for the drivers
  - Extension into the parking zone using scissor extension, since tape measures take time to roll out

FUTURE PLANS:

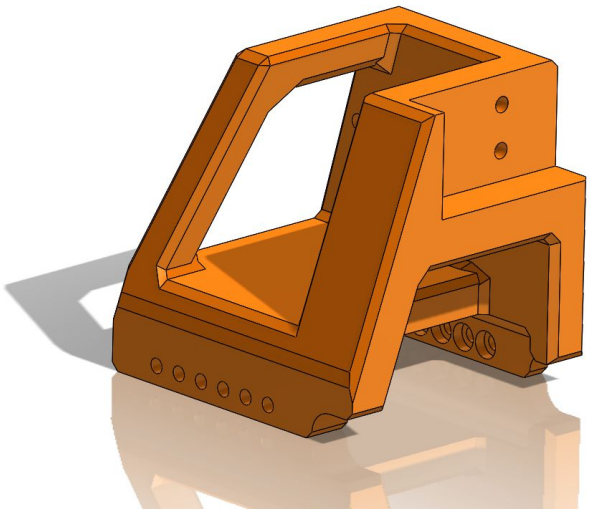
1. Complete Scissor Park
2. Continue Machining
3. Practice driving

Meeting #38

Authors: Andrew, Matthew

OBJECTIVES:

1. **Design Crossbar Mount**
2. **Machined 2nd chain bar**
3. **Assembly Prototype Capstone**



PROGRESS:

- Design Crossbar Mount
  - Sideplates sag inwards at the front; designed a piece to hold an aluminum crossbar
  - Part also mounts motors, to reduce rotational inertia on the intake motors
- Machined second chain bar arm
  - Cut out second chain bar arm
  - Filed out tabs and burrs
  - Waiting for other parts and time to machine
- Prototype Capstone
  - Using cardboard and zipties, formed the rough shape (which is a ring around the nubs)
  - Zip ties were a light and flexible method to reach minimum height barrier
  - Unsure about the release mechanism for capstone

FUTURE PLANS:

1. Assembly new chain bar
2. Improve the capstone design

Meeting #39

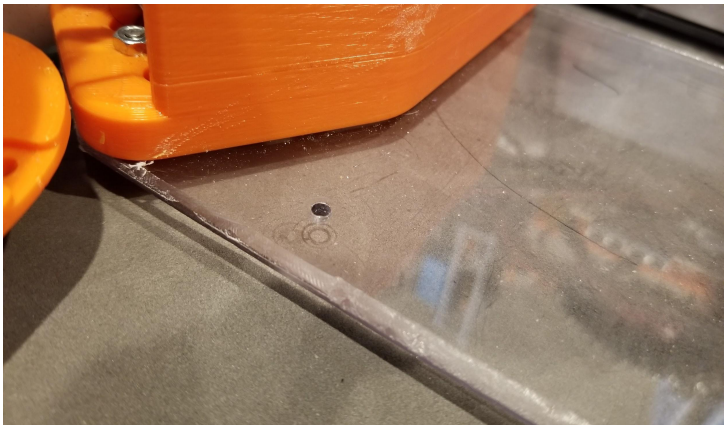
Authors: Matthew, Eric

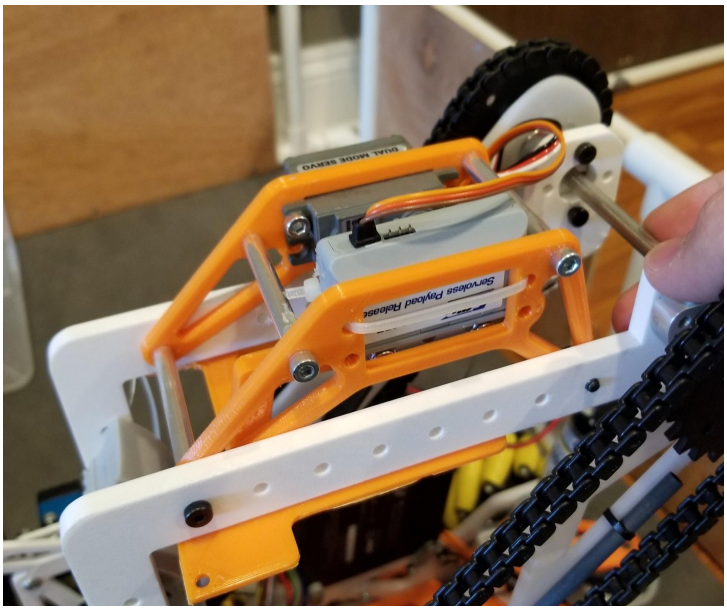
OBJECTIVES:

1. **Printed new stone guides**
2. **Machine and attach bottom plate**
3. **Print Improved Capstone**

PROGRESS:

- Stone guides larger, tighter space to hold the stone
    - Stones sometimes entered tipped due to the space between being not small enough to keep the stone upright
- Bottom plate for the stones machined
    - New guides also offered mounting solution for the new bottom plate
    - Keeps the stone from touching the ground to grab and lift stone on the move
- Print new (competition ready) capstone
    - Cannot make a ring around stone because the stones slip into our grabber
    - C shaped with an arm extending up into the release servo
    - Double sided tape applies an adhesive force to keep capstone on stone





FUTURE PLANS:

1. Chamfer stone pan to allow stones to slide on more smoothly
2. Test capstone for reliability

Meeting #40

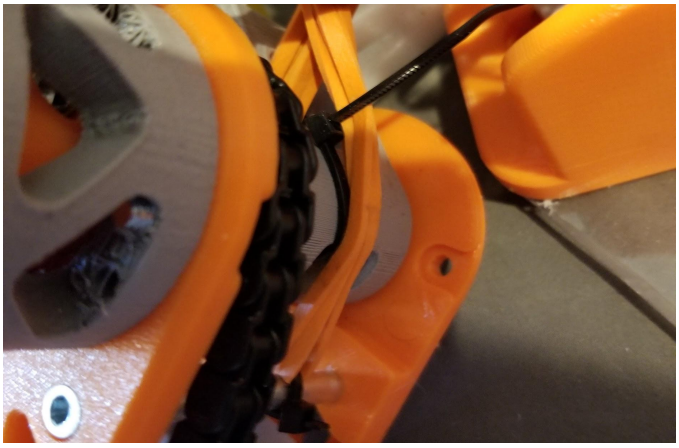
Authors: Andrew, Matthew

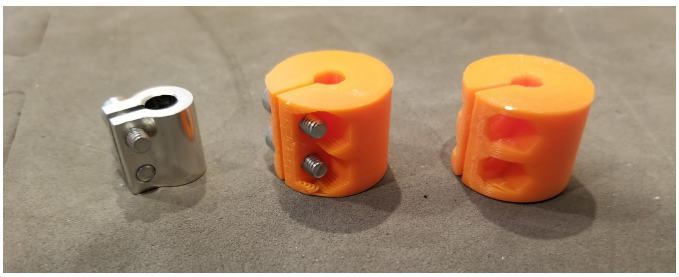
OBJECTIVES:

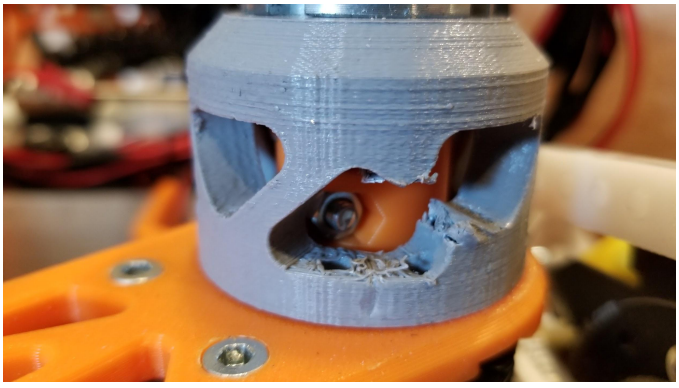
1. **Fix intake springing**
2. **Print MMU team numbers**
3. **Install new intake couplers**
4. **Design and print foundation guards**

PROGRESS:

- Fix intake springing
  - Previous rubber bands kept getting torn apart by moving chains of intake
  - Installed zip tie limiters to protect bands
  - Used zip ties to link together rubber bands for adjustable tension and rest position
- Print MMU team numbers
  - Old 3d-printed team numbers struggled with balancing aesthetic and contrast
  - Printed new team numbers with orange fill and black outline using Prusa MMU
- Improved intake couplers
  - Small smoothbore Gobilda couplers often slipped, and metal threads tore out
  - 3D Printed much thicker and tighter couplers with D-bores and nut countersinks
  - Intake speed and effectiveness greatly improved





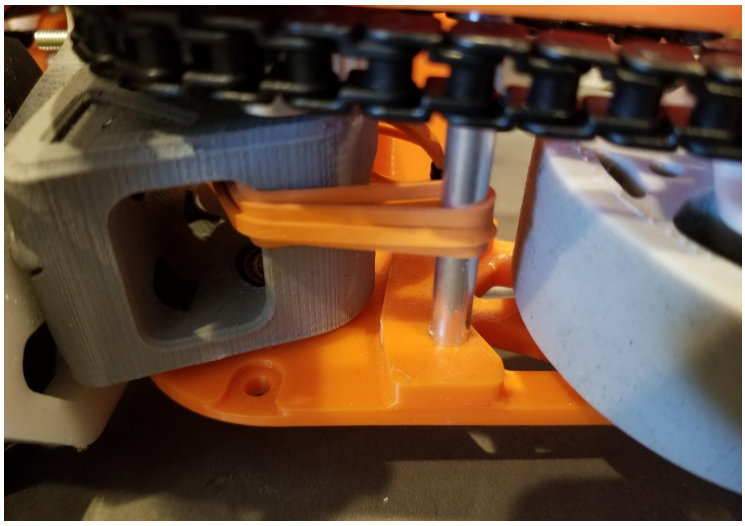


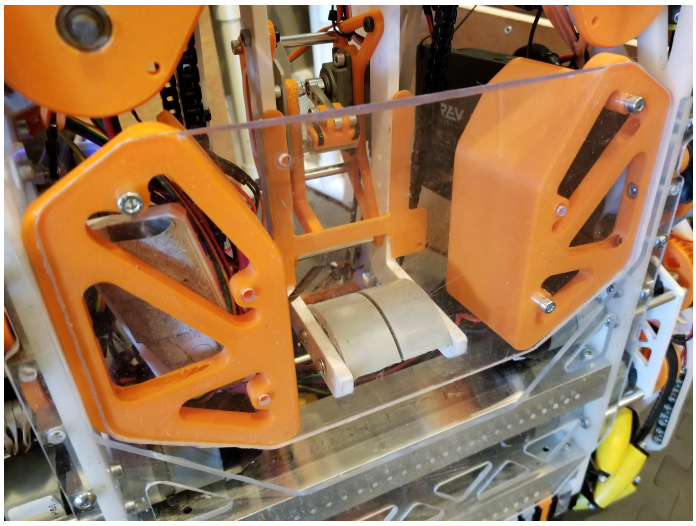
Meeting #40

Authors: Andrew

PROGRESS:

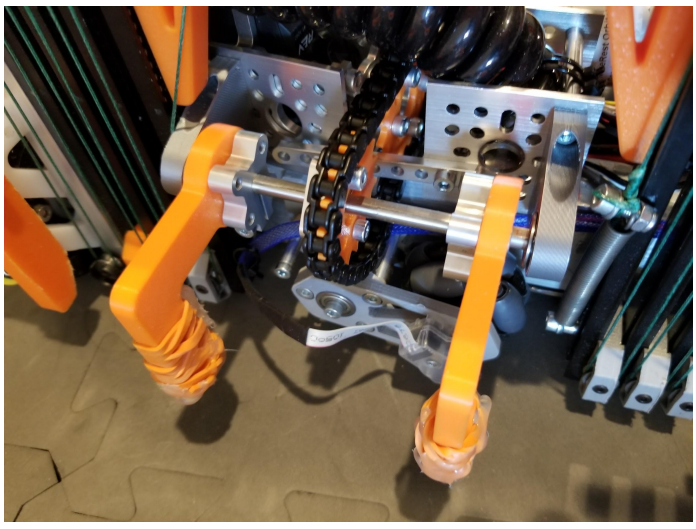
- Install foundation stoppers
    - Designed parts to form-fit sideplate with a single screw to hold them in place
    - Measured sideplate machining error in outer profile vs. inner perimeters, and appropriately accounted for error in 3D model





FUTURE PLANS:

1. Test intake couplers over time to see how they hold up
2. Print thicker orange layer team numbers for both sides
3. Revise foundation dragger
4. Revise foundation dragger mount

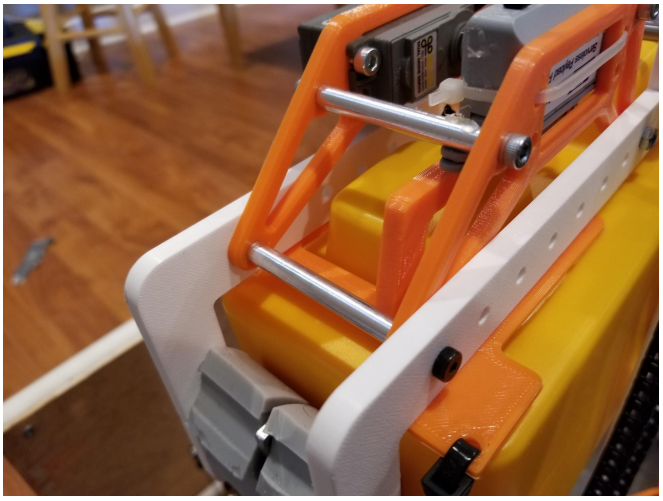


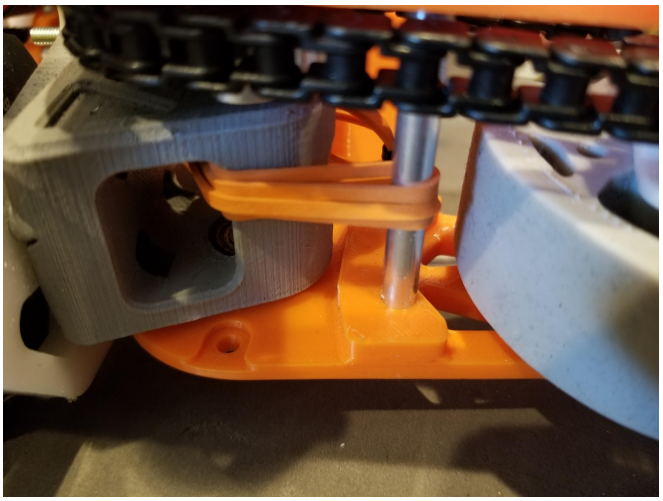
Meeting #41

Authors: Andrew, Eric

OBJECTIVES:

1. **Improved capstone**
2. **Fixed arm wiring**
3. **Installed new foundation grabbers**





PROGRESS:

- Foundation stoppers
  - Prevent foundation from hitting robot's wheels, increasing autonomous reliability
- Version 2 of the Improve Capstone
  - Capstone prevents gripper from holding stones well due to back edge interfering with compliant silicone gripper pads
  - Drilled out larger holes to shift base of capstone back
- Tightened wiring along chainbar to prevent components from getting caught
- Installed new foundation grabber
  - Longer arms for more reach
  - Silicon tipped grabbers allow for a better, more reliable hold
  - Still capable of flipping stones effectively
  - Only one installed: will print mirrored part and install matching grabber next meeting

FUTURE PLANS:

1. Create foundation grabbers with less tolerance for auto precision
2. Improve capstone for intaking

Qualifier 2

February 16th, 2020

Qual 2 Reflection

Authors: Andrew, Eric, Matthew

OBJECTIVES:

1. **Reflect on Sunday Qualifier**

PROGRESS:

- Analyzed our robot's performance and identified issues to fix
- **Intake**
  - Intake tends to kick away stones
    - Add smaller swing-out funneling wheels
    - Redo intake springing so it isn't as swingy
- **Arm**
  - Had issues with arm catching, not flipping, and bending 3D printed parts
    - Resign parts to be stronger, switch to aluminum arm design, debug servos
- **Grabber**
  - Rarely, but occasionally let go of stones
    - Replace servo with stronger servo
- **Foundation Dragger**
  - Tended to release when spinning the robot around
  - Did not allow the robot to turn efficiently
    - Design foundation dragger with wider stance
- **Slides**
  - Still tended to lean, although better than at 1st qualifier
    - Add a second vertical extension string to relieve stress to retraction side

FUTURE PLANS:

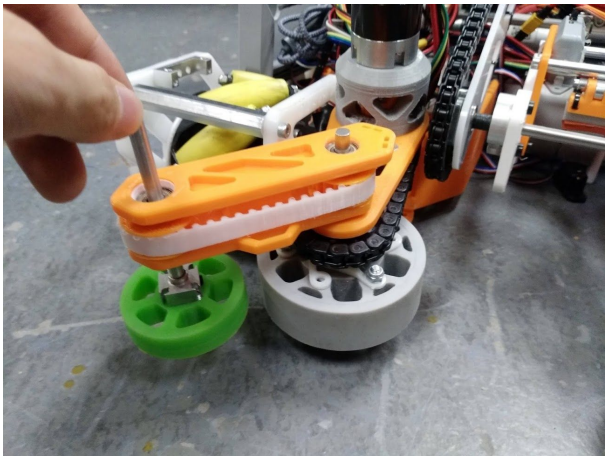
1. Begin modelling and prototyping new parts
2. Integrate new parts
3. Test performance

Meeting #42

Authors: Matthew

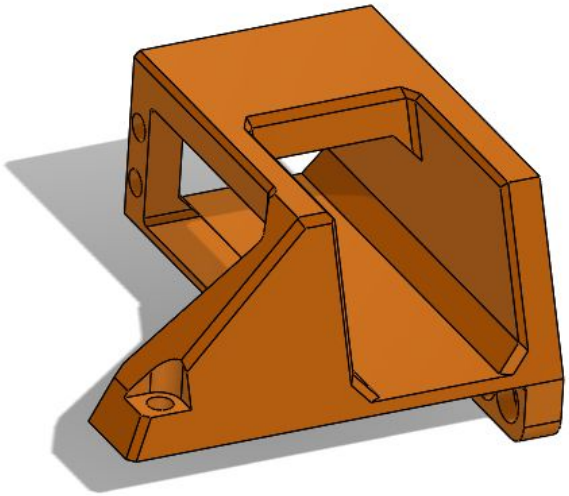
OBJECTIVES:

1. **Attach new intake funnelers**
2. **Attach new foundation dragger**



PROGRESS:

- Attached new intake funnelers
  - Adds another set of wheels that swing out to “funnel” the block into the center
  - Greatly increases the amount of tolerance we have for picking up stones
  - Tested using TPU 3D printed belts
    - Allowed us to test before parts arrived
  - After testing, we found that blocks could get stuck in the “dead-zone” between the wheels
  - In addition, we found that the new intake funnelers tended to flail around too much
- New foundation dragger
  - Foundation dragger mounts are secured at three points across the two sideplates
  - Cantilevered servo sacrifices some rigidity for swift maintenance and accessibility



FUTURE PLANS:

1. Revise intake funnelers to eliminate dead-zone
2. Cut slots in servo mount CAD models to accommodate plans for two-way slide stringing

Meeting #43

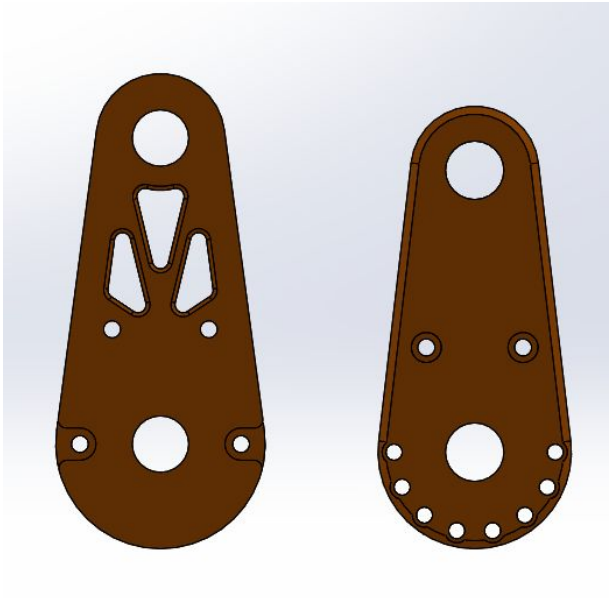
Authors: Andrew, Eric

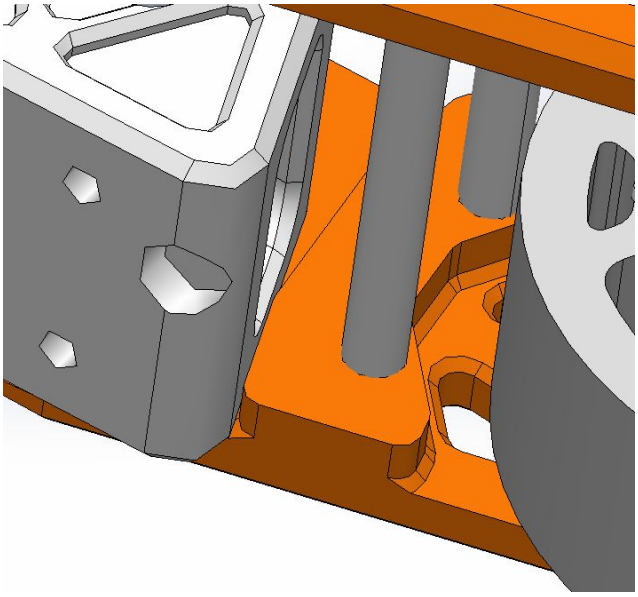
OBJECTIVES:

1. **Attach 2nd intake funnelers revision**
2. **Attach new endstops**

PROGRESS:

- Attached new intake funnelers
  - Contain another set of wheels that swing out to “funnel” the block into the center
  - Greatly increase the amount of tolerance we have for picking up stones
  - Tested using TPU-3d printed belts
    - Allowed us to test before parts arrived
  - After testing, we found that blocks could get stuck in the “dead-zone” between the wheels
  - In addition, we found that the intake tended to flail around too much
- New intake endstop plates
  - Move the wheels to be closer together
  - Wheels make better contact
    - Ensures better intaking
    - Strips plastic coupler due to more force, switching to use a hyper hub





FUTURE PLANS:

1. Revise intake funnelers to have a curved profile
2. Attach new intake motor mounting and cross bar

Meeting #44

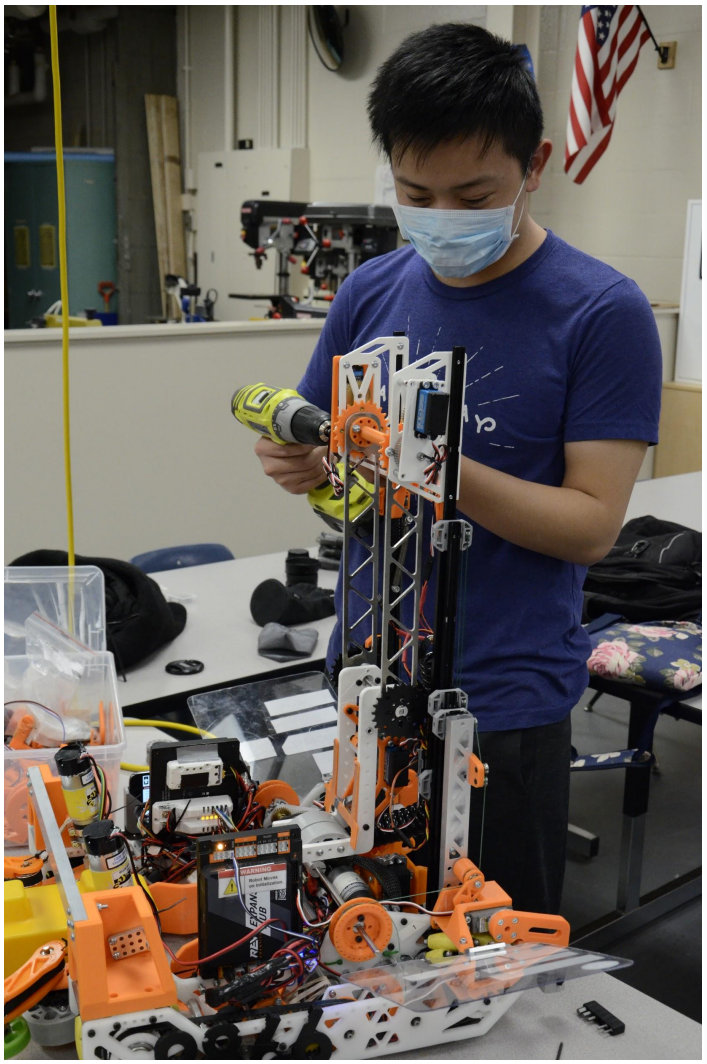
Authors: Curtis

OBJECTIVES:

1. **Installed Crossbeam**
2. **Installed Aluminum Arm**
3. **Installed improved motor mount**
4. **Uninstalled Redundant Foundation Dragger**

PROGRESS:

- Install Crossbeam+improved motor mounting
  - Installed aluminum box tube cross beam to add rigidity to chassis
  - Changed intake motors to mount to the cross beam mounts
  - Used metal intake couplers, should eliminate plastic stripping issues
- Install Aluminum Arm
  - Mounted more rigid aluminum arm plates, did not swap to new chain bar yet mounting though
- Uninstall old foundation dragger
  - Removed old foundation dragger because we had already installed a new one



FUTURE PLANS:

1. Swap to new chain bar mounting

Meeting #45

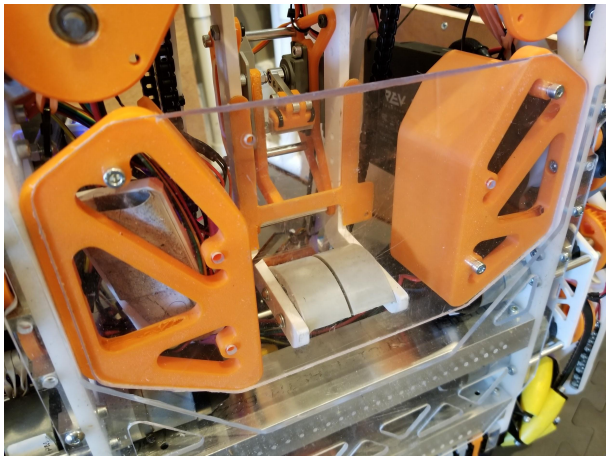
Authors: Curtis, Eric, Matthew

OBJECTIVES:

1. **Respring intake**
2. **Attach new wheels**
3. **FInish attaching aluminum arm**
4. **Reinstall bottom plate**

PROGRESS:

- Intake Improvement
  - Attached a stack of 2 new wheels on each side for the funnelers
    - Better contact than prototype single wheels
  - Resprung intake using springs instead of for more tension to hold it in place
- Bottom Plate
  - Re-added a stone tray on the bottom to prevent stone from jostling
- New aluminum arm
  - Concerns about the arm's fit with the assembly (if the arm was too short it would interfere with the drivetrain)
  - Was an acceptable fit, much less wasted space and more rigid arm



FUTURE PLANS:

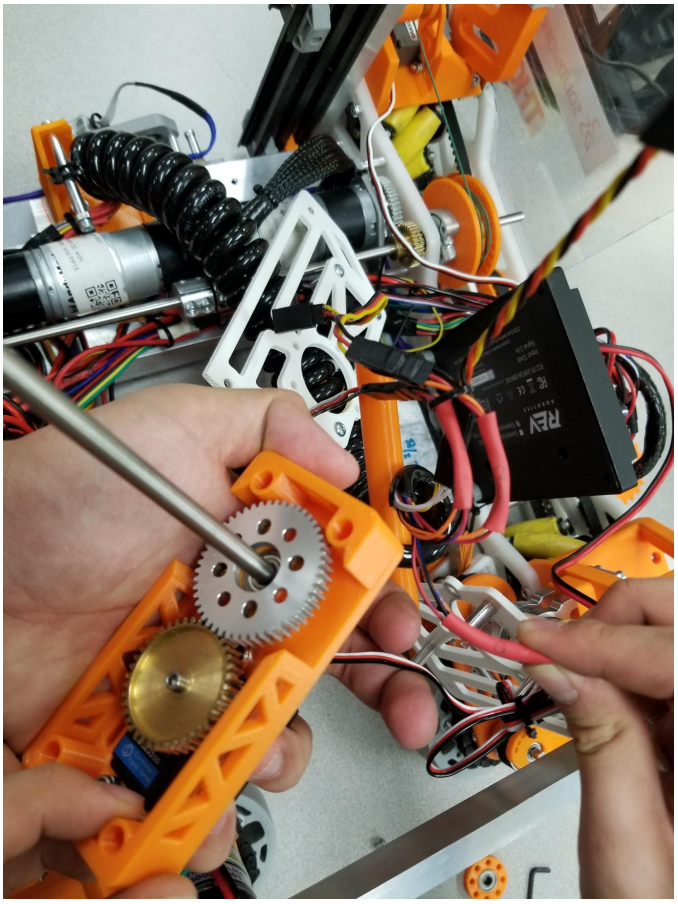
1. Finish installing new arm assembly

Meeting #46

Authors: Eric

OBJECTIVES:

1. **Begin upgrading arm mounting**



PROGRESS:

- Arm Mounts Reprinted
    - Due to the mount's damage and the incompatible design of the mounts, reprinted with new, more rigid design
    - Switch from hex axle to 6mm D-bore, still dead axle but D-bore is adjustable and more rigid
    - Axle mounting much more resilient, not just a thin plate but also walls and supports

FUTURE PLANS:

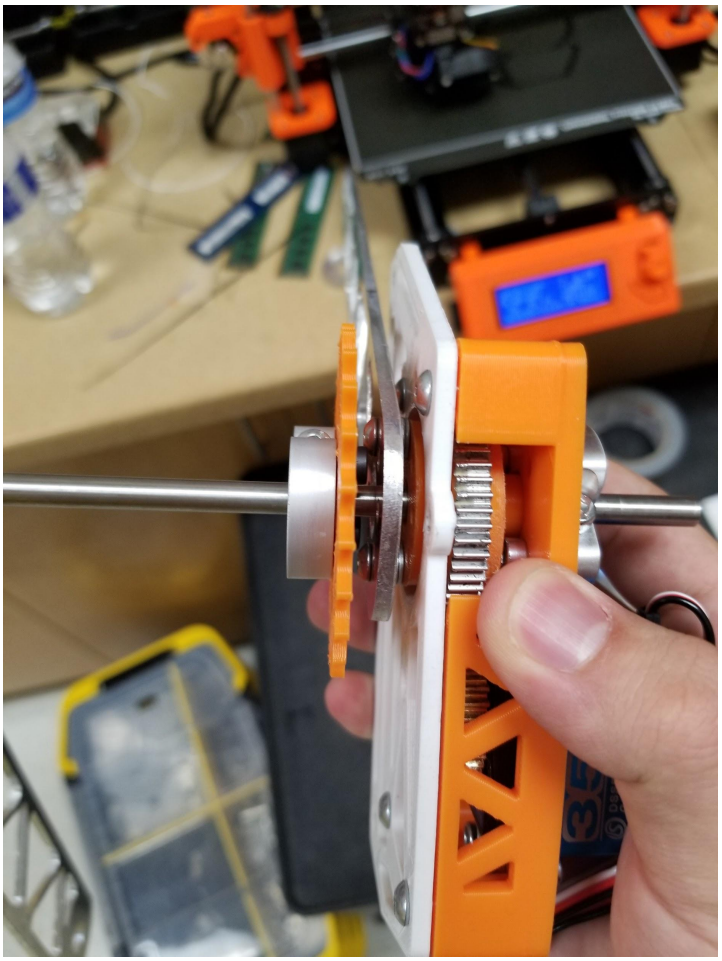
1. Actual construction of Arm

Meeting #47

Authors: Eric

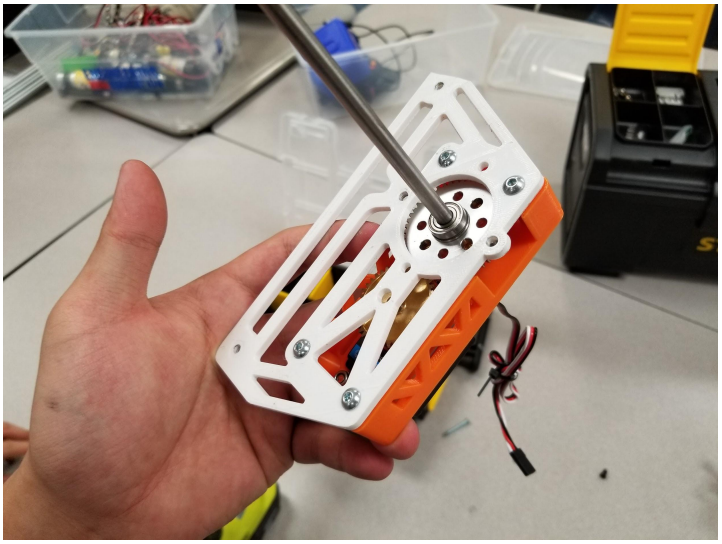
OBJECTIVES:

1. **Further work on arm**
2. **Assemble new grabber**



PROGRESS:

- Arm Construction
  - Spacer length experimented to fit all parts, however sprocket screws interfered with the arm screws
  - Tighter tolerances, ~1.5 mm gap between mounts and arms, provide more space to stone
  - Must adjust spacing with grabber installed and fit onto robot



FUTURE PLANS:

1. Print custom sprockets to accommodate spacing for the base and on grabber

Meeting #48

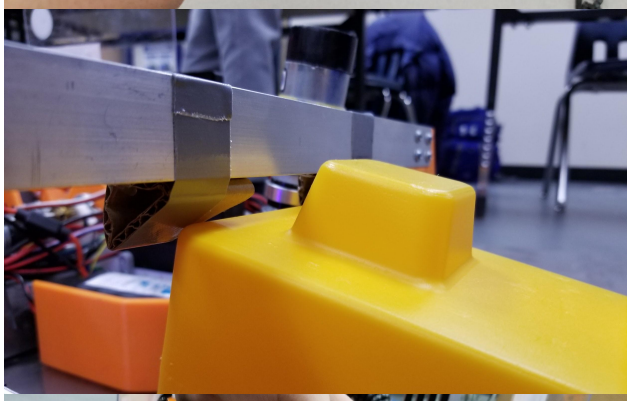
Authors: Andrew, Matthew

OBJECTIVES:

1. **Finalize grabber and arm**
2. **Add "double up, one down" stringing**
3. **Fix stones getting stuck on crossbar**

PROGRESS:

- Finalize grabber
  - New grabber plates printed and assembled with servo components
- Add double up one down stringing
  - Slides had issues with leaning before because one side was strung to go up, and the other down
  - Mounted parts and pulleys to string slides to go up on both slides, made extension much more even
- Fix stones getting stuck on crossbar
  - Improvised a pair of cardboard angled guides to pull the front edge of the stone under the bar to prevent the stud from catching



FUTURE PLANS:

1. Design and 3D print custom countersunk sprockets for grabber
2. Design and 3D print angled guides to push stone under crossbar

Meeting #49

Authors: Matthew, Andrew, Eric

OBJECTIVES:

1. **Finish attaching arm/grabber**
2. **Mount power switch**
3. **Manage Wires**

PROGRESS:

- **Finish attaching arm/grabber**
  - Zeroed servo positions by moving servos and manually adjusting arm position
  - Tightened all the screws to finalize design
  - Fixed a broken connector for the servos
  - Re-attached servoless payload release capstone
- **Mount Power Switch**
  - CAD designed a 3DP power switch mount that was more secure than our duct tape
  - Attached today
- **Manage Wires**
  - Organized wires on the lift and arm to make sure nothing got caught/ripped

FUTURE PLANS:

1. Hand robot off to programmers
2. Driver practice/test

VIRUS 9866

2019-20 Building Notebook

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