SOUPERBOTS

FIRST Robotics Team #203
2021 - 2022 Engineering Notebook

Things WE Need to Do!

- [x] ~~Develop a tutorial on how to install Fusion 360 Educational version for new members - Adam Wahid~~
- [x] ~~Edit chassis to reflect an eight wheel drive with six neo motors~~
- [x] ~~Update the Gantt chart to reflect student leaders and proper design deadlines~~
- [x] ~~Add Link for Game Manual~~
- [x] ~~Prototype of all builds need/should be done by Friday~~ ~~Jan 28, 2022~~

More detailed accumulator plan

- [x] ~~Cut motor hole on side plate to 0.75" this will be done in the CNC machine *check with Sarah before cutting random holes* (this means texting pictures or confirming in CAD which hole will hold the motor)(Also easy to identify because it has two mounting holes directly above and below it)~~
- [x] ~~FINISH CUTTING THE ONE HEX SHAFT AXIS~~
- [x] ~~DOUBLE CHECK THAT THE HEX SHAFT AXIS CAN BE PRESS FITTED ONTO THE .875" BEARINGS if not fix them so they do~~
- [x] ~~Drill and tap the ends of hex shaft for ¼-20 bolts~~
- [x] ~~Cut the mounting plates (file in CAD name CHRIS CUT THIS ONE THIS ONE RIGHT HERE I MEAN IT)~~
- [x] ~~TAP ALL OF THE HOLES FOR WHERE THE BRACKETS MOUNT ON THE MOUNTING PLATE (TAP SIZE ¼ - 20)~~
- [x] ~~Put them wheels pulleys and belts all of which can be found in/around the yellow milk crate on the accumulator and PRESS FIT THE AXIS INTO THE .875" BEARINGS~~
- [x] ~~ASSEMBLE ACCUMULATOR entirely with bearing and hex shaft axis press fitted and motor mounted and standoffs in place (There are 2 already built we might need a 3rd)~~
- [x] ~~Figure out how the pistons will be mounted (current plan is L brackets that will lift it to the proper height better suggestions will be taken)~~
- [x] ~~Mount accumulator to the robot by fitting the brackets to chassis they should be FLUSH WITH GUSSETS~~
- [x] ~~Mount pistons (where they sit on the chassis is demonstrated in CAD) (CAD file name Final Design V2)~~

Climber stuff to do

- [x] ~~CNC Stock~~
- [x] ~~Plasma cut hooks~~
- [x] ~~Plasma cut pulley plates~~
- [x] ~~Plasma cut triangle gussets~~
- [x] ~~Support frame with L stock~~
- [x] ~~Mount pistons~~
- [x] ~~Build pulley plates~~
- [ ] Winch drums
- [ ] Mill hub stock (if possible, not as important)
- [x] ~~CONFIGURE RUBBER BANDS!!~~

Electrical

Please do not remove any zip ties from the robot, they could be very important and need to be done with a mentor's permission.

Pneumatics

- [x] ~~Compressor needs to be hooked up to the Pneumatics Control Module~~
- [x] ~~Compressor needs an actual mount, just a slightly wider horizontally and thinner vertically battery mount will do.~~
- [x] ~~Pressure regulator needs to be added to the pneumatics circuit immediately after the tanks.~~
- [x] ~~Solenoids need to be added for the climber/accumulator and wired NEATLY to the Pneumatics Control Module~~

Chassis

Chassis

Replace wheels when new ones come in
Make sure everything is squared to 90°

Shooter

Currently indexes efficiently and shoots balls near 35ft with an 18ft apogee
Replace bottom aluminum 2x1 pieces that are bending
A more permanent angled mount for the limelight needs to be fabricated and or 3d printed
-if possible- Brainstorm and Replace the orange band with some other system

Robot

Build bumpers
Order batteries
List of spare parts for competition
What side we are putting on robot ei sponsors and decor
Driver station (find old one)
Check to see if we are ok on controllers (where to buy and what)
LEDs for the robot?

Pit

Toolboxes and all needed tools are prepared
Decorations for the pit
Spirit materials inventory
Engineering inspiration booklets
Giveaways (stuff to promote)
Safety materials

- [ ] One if not two arms done minus 3d printed parts
- [ ] Need to know if newest model of gearbox works with the motors
- [ ] Mounting gas shocks onto the accumulator. Work with accumulator and see if it works better with gas shocks (test whenever we can)
- [ ] Better system for flexible accumulator arms
- [ ] Polycarb shooter board
- [ ] Attach other climber for test
- [ ] Fix other climber onto robot
- [ ] Retune PID
- [ ] Tighten bolts
- [ ] Check rope
- [ ] Pistons accumulator
- [ ] Video for chairmens
- [ ] Update outreach book
- [ ] Revise chairman's presentation
- [ ] Review answers for judges
- [ ] Making back up parts
- [ ] Threadlock motor on accumulator
- [ ] Inventory the toolboxes
- [ ] Solid pit rotation
- [ ] Scout rotation
- [ ] Driving practice

Gantt Chart: Click Here

Game Manual: Click Here

Meeting Notes

Date: 1/9/22

Attendees: Tony DePrince, Andy McAlpin, John Kammler, Alan Norton, Shane, Isabella, Anthony, Mikalya, Levy, Kush, Nate, Jaycee
Subsystems Required

- Hanger / Climber
    - 2013 - Ultimate Accent for Ideas
    - During whole time (Investigate this later)

- Accumulator
    - Color / Shape Distinction
    - Floor Pick Up vs. Human Station
        - Investigate timing between the two
        - Investigate loading from human station

- Shooter
    - Goal 8ft - 8 in
    - Flywheel vs Catapult vs Punch
        - Variability
        - Accuracy
        - Speed of Shot
            - Is there a limit to the speed
        - Ease of Build
        - Flywheel
            - Barrel afterward to make shot accurate
        - Punch Catapult
            - Robonauts 118 - 2016 robot
                - https://www.youtube.com/watch?v=sWHwDfpeYjo
            - Maybe multiple at the same time

- Drivetrain
    - 6 Neo Motor Drive Train
    - 8 Wheel Drive Train - 4 Drop Center
        - https://www.chiefdelphi.com/t/8-wheel-chassis-design/121926
    - 4” inch traction wheels

Work Schedule

Tuesday - 2:30PM - 5:45PM
Wednesday - 2:30PM - 5:45PM
Thursday - 2:30PM - 5:45PM
Friday - 2:30PM - 5:45PM
Saturday - 10:30AM - 4:00PM
Start with captains @ 10:00 AM.
Monday - 10:00AM - 3:00PM

Working Groups

- Subsystems
  - Drivetrain
  - Accumulator
  - Shooter
  - Climber
- Field Construction (Friday + Saturday)
- Media Team
- Spirit
- Chairman's / Awards
- Safety

Date: 1/27/22

Attendees: Tony DePrince, Alan Norton, Ryan Loomis, Nate Taylor, Jaycee Norcross, Marlene Smith, Gavin Selenski, Shane Skelly, Danica Doyle

Accumulator

Sarah McGovern (Team Lead)
Bella Davenport
Logan Rossano
Patrick Green

Shooter/Intake

Chris Iuliucci (Team Lead)
Hunter Bauman
Kush Patel
Dylan Russell

Climber
Shane Skelly (Team Lead)
Nick Marino
Hunter Bauman
Nate Taylor
Louis Roman

Chassis
Anthony Brogan (Team Lead)
Danica Doyle
Ryan Loomis
Dustin Cole

Field Elements
Kammler (Mentor)
Nick Marino
Alexa Martinis (Team Lead)
Joel Sesera
Ethan Beres

Awards
Mikayla Gee (Team Lead)

Programming
Jimmy Cuffari (Mentor)
Julius Stewart (Team Lead)
Spencer Murray
Lela Saxton
Alexandra Cupit
Adam Wahid

Outreach
Alexa Martinis (Team Lead)
Jaycee Norcross

Safety
Levy Mai (Team Lead)
Sandra Chila-Flores
Marlene Smith

Design Notes

Chassis

Date: 1/10/22

Workers: Alan Norton

Notes:
From the discussion with the team leaders on Sunday January 9th, the chassis concept was created in Fusion 360 in order to better visualize how the different robotic subsystems will fit within the entire system. All members have access to manipulate the chassis, but should not make edits unless directed to do so. UPDATE: The current chassis does not reflect the final chassis drivetrain. It needs to be modified to include eight wheels instead of six. The motors also need to be changed to neo motors.

Date: 2/16/22

Workers: Chassis Team

Notes:
Chassis rails have been designed using 1” x 1.5” 6061 Aluminum Rectangular Tube with 0.201” holes drilled 0.5 inches apart for a lightweight versatile build. The overall chassis measures 32” x 27.75” giving the robot and overall perimeter of 119.5” meeting the 120” frame perimeter requirement. The chassis was designed in such a way that there all the 32” rails are the same. The same is true with the 27.75” rails. This was done to make the design very easy to manufacture and create spare parts for. The chassis uses eight four-inch wheels driven by a belt system. The Evo Slim gearbox from andymark along with six neo motors are used to drive the robot. The gear ratio of the chassis is 7:56 : 1 giving the robot a top speed of 13.11 ft/sec (approximately 9 mph) and a stall torque of 43.50 ft-lb. The weight of the chassis is approximately 35 pounds including motors.

TODO CHASSIS: Currently our chassis drifts to the right which needs to be fixed. It is expected that the wheel spacers are too large on the right side causing the bearings to be pinched. This needs to be investigated.

TODO CHASSIS: Drawing files should be generated and placed within this document. These drawings should include real-life pictures of the final product.

Accumulator

Date: 1/11/22

Workers: Sarah McGovern, Maxwell Costantino, Logan Rossano

Notes:
Prototype currently in Norton's shop
Approximate distance from bumpers for most accurate collection of Cargo

- Height for accumulator center of churro on prototype 8 1/2 inches off table top
- Distance in length from bumpers approximately 7 1/2 inches

Date: 1/12/22

Workers: Sarah McGovern, Maxwell Costantino, Logan Rossano

Notes:
For prototype: Found necessary belt size(8505M15) and space between pulleys–center to center(13”)– in order to go with the piston idea. Proceeded to cut a plastic side piece that will support the shaft and roller of the accumulator and mount to the shaft with bearings.

Date: 1/17/22

Workers: Sarah McGovern, Maxwell Costantino, Logan Rossano

Notes:

Prototype was completed with all standoffs put in and the motor attached. It is ready to be mounted to the chassis for testing.

Date: 1/24/22

Workers: Sarah McGovern, Maxwell Costantino, Logan Rossano

Notes:
Prototype was attached to the robot and was picking up balls and placing them into the center of the chassis. The only concern is that the accumulator will not pick balls up from a tile floor as the tile floor has no traction meaning that the ball just spins and does not get sucked up. Might need to increase the height of the accumulator so that it doesn't interfere with the bumpers. Also it will need to be moved back so that the bumpers don't have to go in the front. The negative space in the chassis will be kept so that the ball gets directed into the shooter. The accumulator will be moved so that it is 10 ¾ inches from the edge of the chassis.

Date: 1/25/22

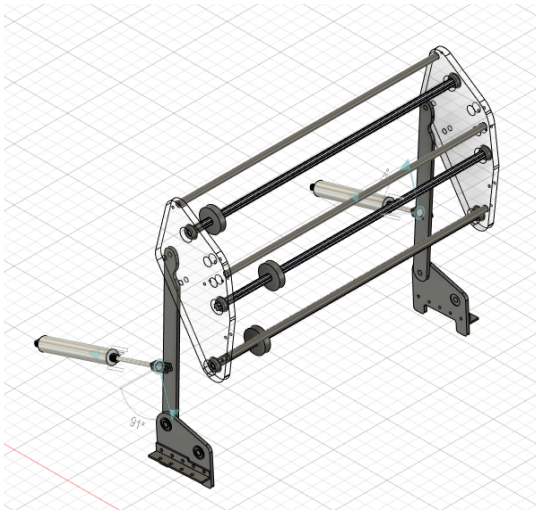
Workers: Sarah McGovern, Maxwell Costantino, Bella Davenport

Notes:
Accumulator was put into CAD so that piston placement can be found. Since bumpers will be placed on all sides the accumulator should not have to be moved.

Date: 1/26/22 - 1/30/22

Workers: Sarah McGovern, Bella Davenport

Notes:
The CAD for the accumulator was finished so that it reflects the distances and correct holes for final design. Accumulator Cad was also placed on the chassis to check for how it would fit.



Date: 1/31/22 - 2/3/22

Workers: Sarah McGovern, Bella Davenport, Logan Rossanno

Notes:
CAD was completed for the 2 bar design. Parts list has started to be created and should be ready to begin the final build.

Date: 2/5/22 - 2/6/22

Workers: Sarah McGovern

Notes:
CAD for the 4 bar design based on team 3636's CAD has been completed and is ready to be cut out if green light is given.

Date: 2/9/22

Workers: Sarah McGovern

Notes:
Started cutting out the pieces for the accumulator so that it can be assembled and tested. The prototype will be cut out of aluminum instead of polycarbonate.

Date: 2/9/22

Workers: Sarah McGovern, Maxwell Costantino, Patrick Green

Notes:
Started assembling accumulators need to widen bearing holes and make small adjustments in the CAD for hole sizes. Sanded down and drilled out holes within pieces to make assembly smoother and put pieces together.

Date: 2/12/22

Workers: Sarah McGovern, Patrick Green, Bella Davenport

Notes:
Accumulator was mounted to the chassis. The intake wheels were put on the bars and were mounted onto the side plates. Structural rods were cut and bolted onto the accumulator. Motor arrangement was mounted. All that needs to be done is put belts and pulleys on it and then mount the pistons.

Shooter and Intake

Flywheel

Date: 1/05/22

Workers: Christopher Iuliuci, Patrick Green, Kush Patel

Attached some 4x2 wheels to a churro and got them mounted on the bot. A really jank hood had been placed and had to be manually repositioned to get a different angle.

Date: 1/17/22

Workers: Christopher Iuliuci, Patrick Green, Kush Patel

Notes: Results of testing

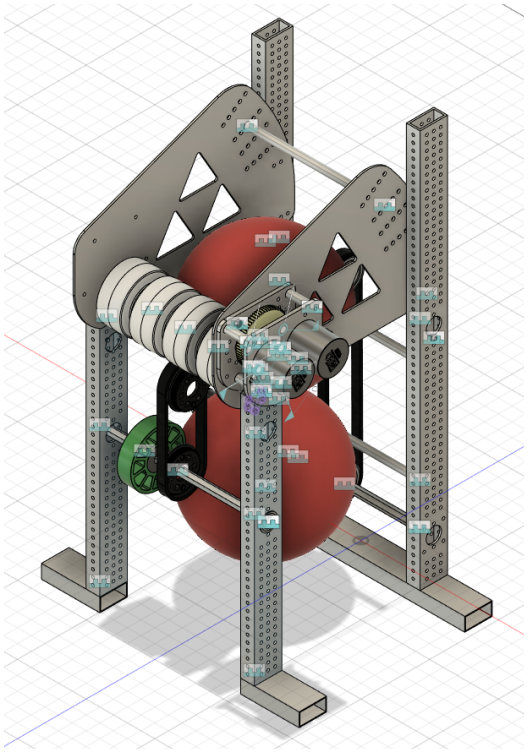
Power Level %	Distance	Max Height	Distance at Which Max Height Was Reached
100%	25	14 ft.	13 ft.
100%	20	13 ft.	10 ft.
100%	28	13 ft.	15 ft.
100%	25	15 ft.	13 ft.
75%	20	7 ft.	15 ft.
75%	20	7 ft.	15 ft.
75%	20	7 ft.	15 ft.
50%	10	5 ft.	5 ft.
85%	20	14 ft.	14 ft.
85%	23	13 ft.	15 ft.
85%	25	13 ft.	13 ft.
65%	15	6 ft.	8 ft.

Date: 2/26/22

Workers: Shooter and Intake Team

Notes: The shooter that was prototyped for this year's robot included four four-inch colson wheels driven by two 775pro VEX motors with a 1.47:1 gear ratio. This resulted in a shooting speed of 8311.11 RPM at a stall torque of 1.42 N-m (1.047 ft-lb). To reduce the build complexity of the shooting system, the team had decided to develop their own gearbox utilizing 2 neo motors instead of the 775pro motors. This change also allowed for the easy use of encoders with increased shooting performance. The new shooter uses a gear ratio of 17:25 resulting in a shooting speed of 8338.81 RPM and a stall torque of 3.835 N-m. A PID controller will be used to reach target RPMs for motors. Motors are not expected to run at 100% power which will hopefully negate the effect of battery drain over time during a match.

The newest version of the shooter was tested over the past two days yielding the following results.



Day One of Testing (Hood of shooter in skeleton form - no plexi backing)

Speed	Distance	Arc	Notes
62%	15-18 ft	High (approx 12-15 ft)	Large difference between the blue ball (fully inflated) vs. red ball (partially deflated). Blue ball flew farther
50%	10-12 ft	Low (approx 10-11 ft)	Large difference between the blue ball

			(fully inflated) vs. red ball (partially deflated). Blue ball flew farther

Day Two of Testing (Hood of shooter with plexi backing - slight bend at end of hood)

Speed	Hood	Distance	Arc	Notes
62%	4-5	15-18 ft	High (approx 12-15 ft)	Consistent. Slight variation between blue ball and red ball. This is possibly due to the fact that the intake was having a hard time bringing the blue ball in before shooting. This has been adjusted.
52%	4-5	15 ft	Low (approx 10-12 ft)	Consistent. Slight variation between blue ball and red ball. This is possibly due to the fact that the intake was having a hard time bringing the blue ball in before shooting. This has been adjusted.
52%	4-3	8-10 ft	High (approx 12 ft)	Very consistent. Has the possibility to reduce shot distance
100%	4-5	32 ft	Very High (approx 15-18 ft)	Max shot. Performed outside with wind. Results indoors may vary.

It is recommended after the days of testing that an articulated shooter hood be implemented into the design. Since vision targeting will be grabbing distance values to control RPM values, the distance could also be used to control an articulating hood between two positions. These two positions should allow the robot to shoot from multiple places on the field while keeping operations simple.

Possible PseudoCode for Shooter

```
distance = distance from Limelight image
tx = offset from center of Limelight image
offset_threshold = ?

if (distance > 15 feet)
{
      Set hood to long shot
}
else
{
      Set hood to short shot
}
```

```
while (tx > offset_threshold)
{
      Fix orientation of robot using drivetrain
}

target_RPM = RPM FUNCTION TO BE DETERMINED
shot_threshold = ?
Run PID controller to meet target_RPM within shot threshold
Run intake after desired shot speed achieved
Wait for stop button to be pressed to stop action
```

Punch

Date: 1/11/22

Workers: Isaac Moran, Danica Doyle, Joel Sesera

Notes:
We tested the punch idea, we tested both an air pressure punch, and a slingshot. Both ideas would not work, and if we tried to make them work we would not have very good accuracy. We should not do this idea, and do either a shooter or catapult design.

Catapult

Workers: Bella Davenport, Tristin Brogan, Victoria Zhou

Notes: The catapult proved itself to be inefficient in shooting power and resources/materials needed

Climber

Date: 1/13/22

Workers - Andy M., John, K, Alan N. (Mentors)

Notes: It was discussed that a climber similar to systems constructed in 2013 Ultimate Ascent should be considered. A couple of links that were shared throughout this discussion:

1. Team Titanium 1986 - https://www.youtube.com/watch?v=uKy-IKDq_6o
2. Team 3572 - https://www.youtube.com/watch?v=axFsxIsaGWY

It is recommended to students that we start to try and reverse engineer the climber from team titanium 1986. In addition to this, a new climber is being sold by AndyMark. The link is provided below. For the climber being recommended, we would need two.

AndyMark Climber-In-A-Box Link:
https://www.andymark.com/products/climber-in-a-box?via=Z2lkOi8vYW5keW1hcmsvV29ya2FyZWE6OkNhdGFsb2c6OkNhdGVnb3J5LzVhZjhlNDRjYmM2ZjZkNWUzNmYyMzlmZg

CAD Models of the climbing pipes as well as the climber in a box have been placed into the 2022 Robot CAD Files Folder for Fusion 360. All are welcome to copy the files and play around with the geometry to get a feel for how our climber may work.

Date 1/15/22

Workers - Shane Skelly, Nick Marino

Created prototype arms and piston joints based on team 3572's 2013 climb.

Date 1/22/22

Workers - Shane Skelly, Chris Iuliucci, Hunter Bauman

Attached arms to a frame set to be placed on the robot. We also weight tested the lift by having Hunter (145 lbs) pull himself up using the robot frame.

The winch works and we will now begin testing where the second hooks that hold the robot in place will be positioned at.

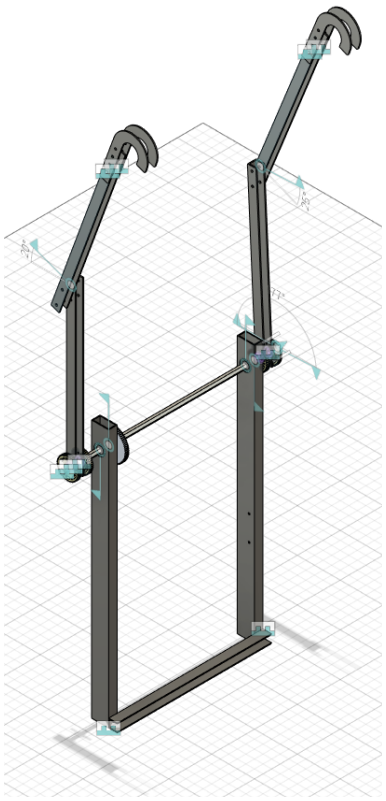
Date 2/23/22

Workers: Hunter Bauman, Shane Skelly, Nate Taylor, Kush Patel, Victoria Zhou

The lift prototype was attached to the robot this week and successfully traversed to the final bar. The cad file has been created and we are now beginning to manufacture the parts and assemble them.

Some necessary changes have been made to the design. The motor setup to rotate the arms was replaced with two pistons, and the arms are going to be made self contained to reduce wobble.

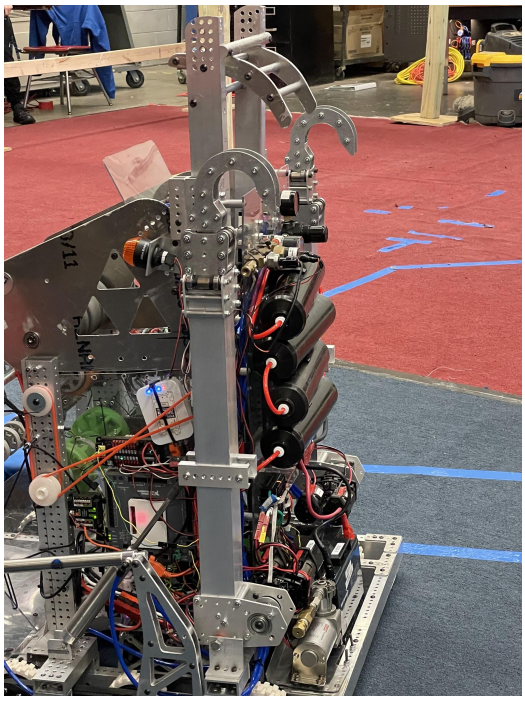
We also have a team working on using pieces of metal L channel to support the frame of the lift on the chassis.



New Version Climber

Date 3/14/22

Andy Mark Climber in a box



- Linear arms using the AndyMark style arms
- Running along vulcan springs and 3D printed sliders
- Custom CNC’d brackets mount pistons to the outside of the arms

- The arms are able to fully extend, reaching the next highest bar, without leaving the robots constraints
- The design of the stationary hooks, along with the pistons, allow the arms to traverse faster than previous designs
- We can climb with our accumulator extended or retracted
- The swing is controlled and our hooks have proven themselves with many angles of rotation

Human Loading Station

Date: 1/11/22

Workers - Gavin S, Ryan L and Jesiah R

Notes: Layed out a basic ramp to roll balls down from several different heights including the one that will be used in competition. The first drop of the balls is around 18 inches away from the bottom of the ramp. We need to find a way to position and configure the robot 18 inches away to deliver the balls into the robot's shooting compartment easier.

Date:1/12/22

Workers - Marlene S, Isaac M and Jesiah R

Notes: Tested more heights and variations of the ball drop of the human terminal. Need to identify angle and trajectory of the ball to better determine the position of the robot.

Date:1/13/22

Workers - Gavin S, Isaac M, Marlene S and Ryan L

Notes: Completed the trajectory calculations and figured out a possible angle of 67 degrees for the ball drop onto the robot. Ball needs to just be dropped onto the ramp and not pushed to keep the speed of the ball low and not cause a bounce of the robot. 18 inches is still the correct distance away from the end of the ramp for the position of the robot.

Programming

Date: 1/11/22

Workers: Alex C, Julius S

Notes: Learned the basics of java. Took a look at the robot placing all it's parts with the software. Took a quick look at the code for FRC and tried to figure it out/ explain it thoroughly. Practiced coding basics that were learned.

1/13/22

Notes : We wired it and readied it for driving. Fixing the board and soldering the wire needing to be soldered.

1/14/22

Notes: Readied it for driving and started programming the shooter. Practiced and used the code on the old robot.

1/15/22

Notes: Finished and patched up the wiring and fixed the issue with the drive so we were able to connect and run the shooter.

1/17/22

Notes: we tested the shooter, and measured distance + height with different speeds. We worked on the accumulator and its code so it should be ready to test on tuesday. We did some more practice with the old robot and corrected errors in the previously made code. I learned how to import links.

1/18/22

Notes: We remounted the electronics board to the shooter. We made extension wires and discussed the action plan for tomorrow which is to test the accumulator.

1/19/2022

Notes: We started to move the electronics from the acrylic to the side of the shooter. We got the rio up but had to move everything else to make sure there is space for the pulley system. We need to make sure that all the systems are able to fit without damaging anything.

1/20/2022

Notes: Finished the electronics on the prototype. We had to move it back to the acrylic because of spacing issues and we rewired the board. We tested the ther electronics and checked the ports to the motor controllers. We also deployed the code into the rio. Learned a little bit more about voltage.

Workers: Alex C, Julius S, Adam W

1/24/2022

Notes: Reconfigured radios so that they connect and work correctly, and then began coding in the pistons/pneumatics, as well as updating/expanding the GitHub and Java itself.

Field Elements:

Workers: Kammler, Alexa Martinis, Nick Marino, Ethan Beres

1/15/22
Notes: Prints were handed out and assembly began on the “Hanger”.

1/17/22
Notes: Assembly of the “Hanger” finished.

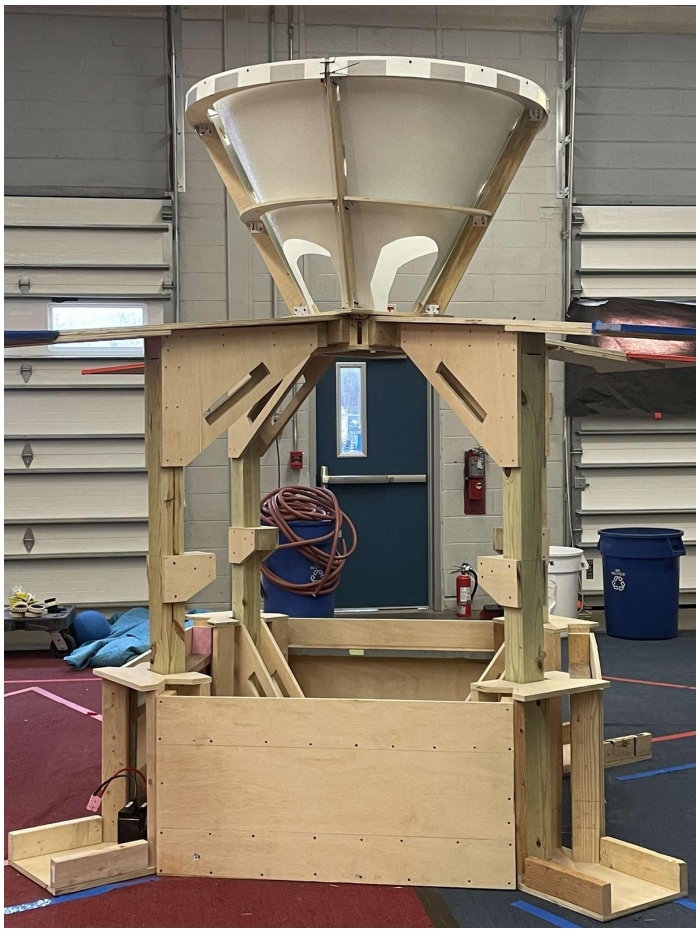
1/18/22
Notes: New prints handed out and assembly began on the “Terminal”.

1/22/22
Notes: Assembly of the “Terminal” finished.

1/24/22
Notes: New prints handed out and assembly began on the “Hub”.

2/16/22
Notes: Assembly of the “Hub” finished.

3/24/22
Notes: Construction of the “Driver Stations” and “Field Perimeter.”



The Hub

- All the 4x4 posts are connected by the small edge pieces wrapped around the base, they are also being supported by their own construction.
- Having support from the bottom will easily allow the posts to be supported from all angles and to not fall backwards.
- The posts are only built on a 90 degree angle at the bottom, and about a 95 degree angle at the top.
- It’s not very stable without other builds to counter it and will fall over.

Human Player Station

- The back of the build is at a higher elevation than the front, this is used for rolling the balls out onto the playing field from the aluminum rails for the robots to pick up.
- There's a small ramp for the balls to enter, with bars in the way so the robot can't hit the humans.

Climber Station

- The front and back posts are equally spaced so the bars won't be messed with while climbing.
- They are also on the same elevation on each side so you can test the robot on any part of the bars.

The Field

- This is showing the whole layout of the field and the correct distances from each other.