Grizzly Bots 11918

Skystone 2019-2020 Engineering Notebook

Grizzly Bots 11918

Summary

The golden rule of writing EN entries is to do them on time. The more you procrastinate, the less you remember and the more work you have to do.

We are proud of what we've built and how far we've come. We've gone through our 4th complete redesign of our robot. However, we didn't start work on our engineering notebook until half way through the building of our robot. That was a mistake, and for that reason, this engineering notebook is not the best it could've been. We have learned from our mistakes, and we are working our hardest to make this season the best we can.

Because of this, we have chosen to organize our EN a little differently. Instead of having entries for each individual meeting date, we have decided to create sections for each major design iteration, and pages around important components of our robot.

We would like you to look at pages 29-39. Thank you for reading our engineering notebook.

We are the Grizzly Bots.

Table of Contents

Meet the team

We are based in Leander, TX, about 30 minutes north from Austin, TX. Our school, Glenn High School, opened in 2016, and our team has been active in FTC for 4 seasons.

This season has been challenging, as almost everyone on the team is new to robotics. However, we have worked very hard to learn, problem-solve, and to adapt to new situations.

Emily Wagoner | Coach/Sponsor
I coach robotics because I love science and engineering, and it gave me the opportunity to let students explore how to solve problems with technology and coding.

Myles E. | Class of 2023 | Hardware + Software

Kiera B. | Class of 2022 | Software
I joined robotics because it's similar to what I want to do for a career, so robotics is a good opportunity for me to see how I work with others in something I like

Brody W. | Class of 2023
I joined robotics because because I love engineering and getting to build things. In my free time I like to read and babysit, and drink a lot of soda, and eat a lot of junk food.

Meet the team

AIdan F. | Class of 2022
I joined robotics because I'm interested in engineering and robotics, and I was in gateway at LMS. As a marching band member, I'm not able to come to robotics often, but I like to help build. Robotic s is a fun challenge to anyone who enjoys building or working with computers. I enjoyed working with a team to build this robot.

Adam M. | Class of 2020
I joined robotics because I'm planning becoming a mechanical engineer so this was a logical step to take. I've been here for all 4 of my high school years and I don't regret my decision. That moment when there are only minutes left to fix your robot before a match with only your wits and a few tools to aid you is one of the biggest rushes you can experience.

Jason A. | Class of 2022
I joined robotics because I've always been interested in building stuff and writing code and robotics lets me do both. It's really cool being able to see something I made as a physical product. I love doing software projects on the side, but there's nothing like getting something in the physical world to be affected by something that you did in a virtual world.

Alex P. | Class of 2020
I joined robotics because [I wanted] to hone my skills with software and hardware alongside people that shared the same interests as me. Designing and building the robot was [a] much different task than programming it. I had been on software for years and thought to take the plunge in learning tools and parts. I loved every second of building the robot and getting to know the people in robotics.

ITERATION 0

The first thing we did was disassemble our existing robot. We chose to do this in order to fully understand the workings of the robot, especially since all but one member was a veteran of our team. This took about 4 weeks or 8 1 hour sessions. Through this process, we became familiar with the different tools we would need to use throughout the season.

ITERATION 1

Hardware

For our first iteration, we decided to follow the REV Basic Bot Guide provided by FIRST. We did have problems on step 3 of the Drive Assemblies and Frame section. On one of the sides, we realized there is a little leeway in between the motor and the bracket because we forgot to add one spacer. We fixed this on one of the sides, but when we tried removing the bracket, one of the screws started to strip. We tried other ways of replacing the screw, but disassembling the assembly turned out to be the best solution. Once we fixed that, we managed to finish the steps, and we had our first robot!

Software

We had planned to use Blocks or not so that we could test the robot after building the 1st iteration of the design and then switched over to Android Studio for our control system. However, we had issues getting Android Studio set up and installed, so we ended up using Blocks for the whole season. This ended up not being as bad as we had thought, however, it was difficult seeking programming help, as many of the teams in our area use Android Studio.

For the first software iteration, we used a sample which was built into Blocks. This allowed us to get started quickly.

ITERATION 2

Hardware

We now had a fully moving robot, with Omni wheels and basic code. However, we had no way of moving or lifting stones, with little time before our 1st qualifier meet to devise an elaborate lift system that would allow us to score the most points. The idea for our first arm was very simple. This idea was not originally designed to work as an arm. It was quickly thrown together to do a quick test of a motor until one team member pointed out that we could grab the midsection of the stone and drag it around. We named this design “Slappy” because it ‘slaps’ the stone in order to manipulate it. This design stayed largely the same until after the 2nd qualifier meets, allowing our drivers plenty of time to practice moving blocks.

Software

The software stayed largely the same. We simply added controls for the motor that controlled Slappy.

1ST QUALIFIER MEET

St. Dominic Savio HS, Nov. 9th 2019

We did pretty well. We were in an alliance that had a robot stop working during the match and we were able to move blocks so that they would still get points. We did have to rewire some stuff during the inspection because it was messy, but we still passed inspection.

Other teams had robots that could move the foundation and stack the blocks, so we brought the blocks over to the foundation in order for them to get points, which meant that they didn't have to realign themselves to the skyscraper before stacking. We saw other teams with mecanum wheels that allowed them to move forward, backward, and strafe left and right, and decided to look into using a set on our robot.

ITERATION 3

Hardware

We completely dismantled our current robot to make way for a new lift that we were working on and mecanum wheels. We also introduced a second Expansion Hub in order to have more motor ports. We ordered the mecanum wheels but realized that we needed more stuff like axles to put everything together. Once we got everything, it was difficult to assemble everything. We had issues with spacers between the wheel and the bracket that attached it to the extrusion.

Software

We made changes to our autonomous op mode because the mecanum wheels needed slightly different programming. However, we weren't able to test the autonomous period before the next qualifiers, as the robot was still not working.

Mecanum wheels function completely different from Omni-wheels, causing us to have to basically start from scratch. With mecanum wheels, each one has to be facing a different direction, meaning coding will get more complex than with the Omni-wheels. However, with the mecanum wheels, it is easier to strafe, because mecanum wheels allow for faster turning and, unlike Omni-wheels allow for the ability to strafe, therefore the mecanum wheels seemed like an overall better option.

We used the same claw however until championship so that was really the only part of the original code left unchanged.

2ND QUALIFIER MEET

Westwood HS, Dec. 7th 2019

This was our first meet with the new mecanum wheels. Our robot was not fully functional at the end of the build session the day prior, having been riddled with software issues. We eventually figured out that we had the robot configuration wrong, as we had switched to using 2 REV Expansion Hubs and had switched around which motors were on what hub. Once we fixed that, we were good until our battery started dying. This would have been fine if we had extra batteries, but we didn't. We had forgotten to pack some spare equipment and tools. After this meeting, we developed a checklist of all cables, tools, and other equipment needed so that we wouldn't accidentally leave equipment at school. The battery dying led to a sporadic motor movement, which also led to the frequent jogging and disconnection of the USB OTG cable from the expansion hub. We had other issues with our Expansion Hub connection, and we think ESD was also a factor.

2ND QUALIFIER MEET
(cont.)

We got penalties for accidentally moving 2 blocks at the same time. This was because part of our robot was open at the front, allowing blocks to slip in. We planned to solve this by adding an extrusion in the front.

We also had issues during our autonomous period. Our plan during the autonomous period was to simply park underneath the bridge. However, the robot has to be right up against the wall. The friction of the wall prevented the wheels from moving. The battery dying did not help the situation. We decided that we would put some form of covering around the wheels so that this situation wouldn't happen again.

ITERATION 4

Hardware

After many months of work, we got the lift built. We were finally ready to mount it. We had to make some adjustments to accommodate it, but it worked. Kind of. The lift works by using pulleys to pull the ends of the extrusions closer together to lift them up higher. We got a kit for it on the Rev Robotics website (Linear Motion Kit), then modified it to make it more efficient. We chose a lift because we wanted to have a way to lift the block high enough to stack the blocks on top of one another. The lift's compactness made it seem like the best choice given the situation. We had some issues building the lift like screwing screws into the bottom of the extrusions because they aren't threaded and had a similar amount of difficulty adding the slider panels as you have to install the slider panels on a specific side of the lift will go the wrong way, thereby requiring us to rebuild much of the lift when we made a mistake.

We used the claw design to manipulate the game elements; as stated before, the claw served a dual purpose, first being to lift and stack the block and the second being to quickly and easily move stone through our alliance bridge.

We decided to name the claw Woody. We got the name "Woody" because when the claw was closed it looked similar to the beak of a woodpecker. There is a cartoon character named "Woody the Woodpecker", so we felt that the name would be an appropriate moniker for the robot.

Software

We had already coded the mecanum wheels, so all we needed to do was add in the motor that controlled the height of the lift and the servos for the opening/closing of the claw, as well as the tilt of the claw. Unfortunately, due to time constraints, we weren't able to test Woody.

3RD QUALIFIER MEET

Vista Ridge HS, Jan. 11th, 2020

For this meet, we continued to use Slappy, as our lift was not fully ready yet. We did pretty good as a team. We improved our team communication, and we were better at cooperating with our alliance. We didn't have any Expansion Hub disconnection issues, which is likely due to the application of an anti-static spray onto the field. We were also able to do better as we had all the necessary tools and batteries to operate and maintain the robot as needed. However, we still had a number of issues. While we tested the movement on the robot, the movement was very irregular. After we put Slappy on "Good Boy" our old robot, he had a screw put on in the wrong direction, which prevented us from moving blocks. We also had several screws in unnecessary spots. After we got the wires hooked up to the robot, we had a huge messy wire area, because wires were everywhere, and it was hard to tell where and what wire went where.

ITERATION 4 *(continued)*

Hardware

We never got the chance to test Woody before our 3rd Qualifier Meet, so we decided to take Slappy off and continue working on Woody. After testing the lift, we found that it was too unstable to handle the motor's power and the pulleys had a large amount of friction, causing us to reevaluate the design to account for these problems.

One issue we encountered when testing the claw on the robot was that the claw was simply too heavy for the servo to handle on the linear lift. We had some issues after the claw was built, like when the blocks were turned over the chances of us getting it went substantially lower.

Software

We had already coded the mecanum wheels, so all we needed to do was add in the motor that controlled the height of the lift and the servos for the opening/closing of the claw, as well as the tilt of the claw. Unfortunately, due to time constraints, we weren't able to test Woody.

ITERATION 5

Hardware

As we continued to work on Woody, it became clear that the problems began to outweigh the positives of the entire design. The pulley system had too many risks of failure, the frame was unstable, wire management was a disaster. A week prior to us visiting an elementary school, we decided to create a drivable demo robot for the kids to have fun with. Surprisingly, the robot built as a joke started to show potential as a future competition robot. We gave the robot the name “Lil’ Monster” since the bot was not only smaller, but it was way more powerful than we had anticipated. Lil’ Monster became the team’s main focus a week prior to the championship and was starting to show some extreme potential. The wheels were basic wheels with spinners along the edge to allow side to side movement. We had placed two on the sides and one in the front to accomplish some strafing, albeit unreliably without the use of mecanum wheels. The arm used to pick up the blocks was powered by a motor and two gears. The arm itself was a pivot system using two arms that kept the block level with the ground as we picked it up. The claw was powered by a servo that simply clamped down on blocks with rubber bands on each claw-arm to give it extra grip.

Some problems that arose with Lil’ Monster’s initial design was that the gears powering the arm were constantly binding. This resulted in a very inconsistent arm movement and potential destruction of our frame. Another problem was that it didn’t fit within size restrictions.

Software

Our software didn’t have much for when we first made Lil’ Monster. It had the basic movements: Forward, Backward, turning Left and Right, and also moving the claw up and down.

ITERATION 6

Hardware

As we continued to work on Woody, it became clear that the problems began to outweigh the positives of the entire design. The pulley system had too many risks of failure, the frame was unstable, wire management was a disaster. A week prior to us visiting an elementary school, we decided to create a drivable demo robot for the kids to have fun with. Surprisingly, the robot built as a joke started to show potential as a future competition robot. We gave the robot the name “Lil’ Monster” since the bot was not only smaller, but it was way more powerful than we had anticipated. Lil’ Monster became the team’s main focus a week prior to the championship and was starting to show some extreme potential. The wheels were basic wheels with spinners along the edge to allow side to side movement. We had placed two on the sides and one in the front to accomplish some strafing, albeit unreliably without the use of mecanum wheels. The arm used to pick up the blocks was powered by a motor and two gears. The arm itself was a pivot system using two arms that kept the block level with the ground as we picked it up. The claw was powered by a servo that simply clamped down on blocks with rubber bands on each claw-arm to give it extra grip.

Some problems that arose with Lil’ Monster’s initial design was that the gears powering the arm were constantly binding. This resulted in a very inconsistent arm movement and potential destruction of our frame. Another problem was that it didn’t fit within size restrictions.

Software

Our software didn’t have much for when we first made Lil’ Monster. It had the basic movements: Forward, Backward, turning Left and Right, and also moving the claw up and down.

ITERATION 7

Hardware

The final iteration of Lil' Monster would be the one we would take to the league championship. The main problems that required fixing were: the arm's gear binding extremely bad, the movement was very janky, and it didn't fit within size restrictions. First, the arm. The arm's binding was fixed by swapping out the gear with a chain to avoid any binding, friction, and tearing of any kind. As a result, the arm ran extremely smooth with little to no loss of force from the motor to the claw. Secondly, the sizing. We had to move everything back in the robot in order to fit within restrictions. The only thing we had to move was the arm. We added a REV Resistive Grounding Strap to help with ESD issues. Lastly, we installed an extra motor on the back of the robot to give the robot true strafing capabilities.

After final hardware decisions were made and edit to the robot were completed, the only problems that remained were: messy wires underneath the robot and there was a fair bit of clutter all around the robot, which we fixed.

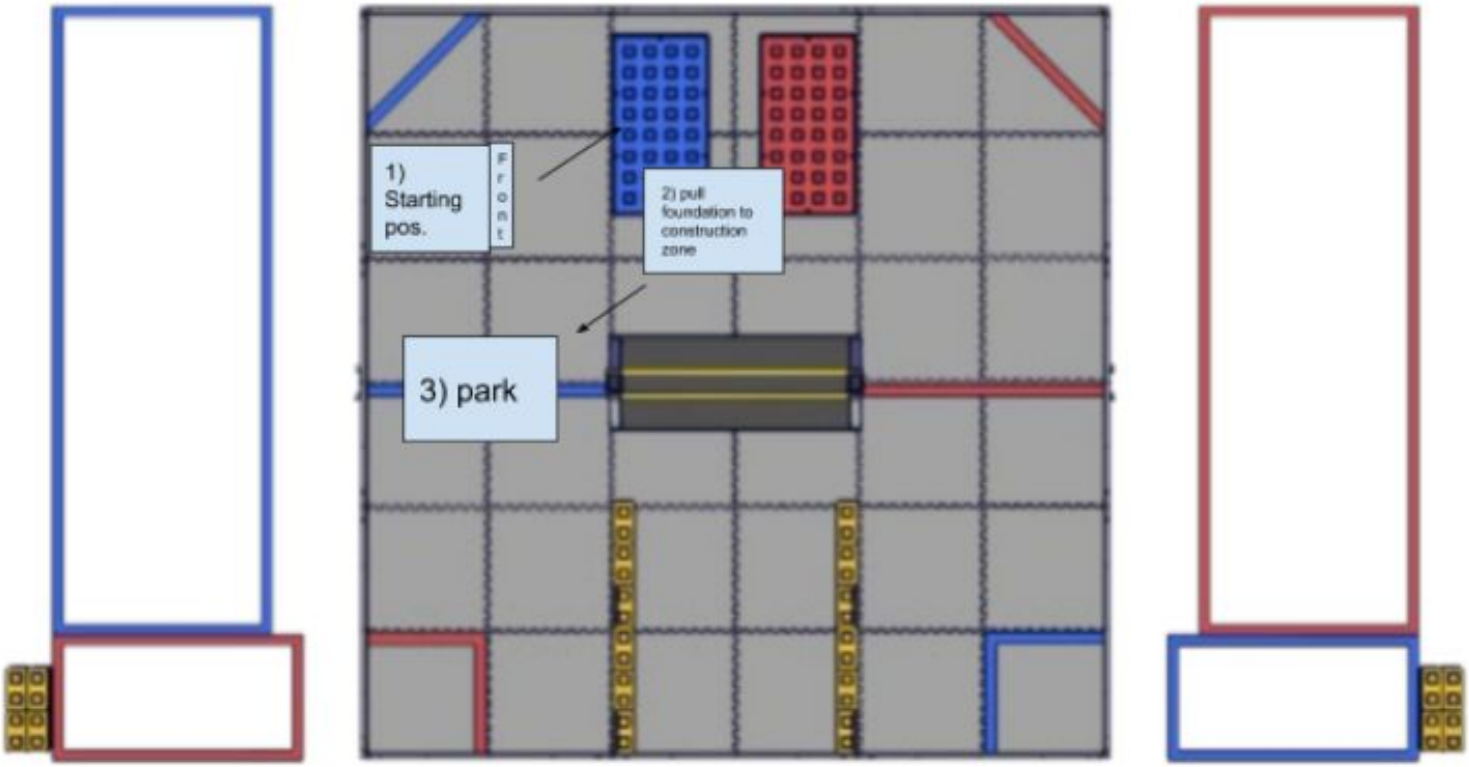
Lastly, we added a servo with an extrusion attached in order to move the foundation in end game.

Software

As Lil' Monster was improving, so was our code. Our finalized code had become much more refined than Good Boy's, and we were very glad about that. In fact, the only things we really had to change with Lil' Monster's code was the power for the motors and servos.

We had planned to create an autonomous which would allow us to move the foundation in to the build site, using sensors to navigate around the field.

However, due to time constraints, we created a simple autonomous which allowed us to park under the bridge.



OUTREACH

Blueprint Night, Jan 22

10 hrs of outreach

This was an event where incoming and current students came for an intro to our school and to look at clubs and organizations they may be interested in joining. We talked to incoming 8th graders and current students about our team and robotics and allowed them to demo a test robot, which later became our competition robot. About a dozen people stopped by our booth.

OUTREACH

Plain ES Science Night, Jan 30

6 hrs of outreach

This was an event hosted by one of our feeder schools, so we decided to reach out to them and see if they would let us demo our robot in their library. We had about 50 students and their parents talk to us about our team and the benefits of being on robotics.

OUTREACH

Feeder elementary school visits, Jan. 15th-16th
3 hrs of outreach
Our feeder elementary schools took a tour of our school. We got the chance to talk to them about robotics and also give them 3d printed badges and laser cut keychains.

OUTREACH

Future Outreach Events

- **Girl Scout Troop**
  - They won't be available until the fall, but we plan to talk about robotics and STEM, and allow them to demo a robot.
- **Grizzly Bots + Danielson MS FTC team**
  - A new school is being built across the street from ours, and since the school is new and will likely not have an FTC or FLL team, we would like to give them the opportunity to join our team. We have contacted them, however, as of 1/31/2020, we have not received a reply.
- **e-NABLE**
  - We plan to get registered with this organization. This is an organization that matches people with 3D printers to people who need prosthetic limbs.

OUTREACH

Future Outreach Events (cont.)

- **Camacho ES STEM Night, March 2nd**
  - This event is going to be run in a similar format to the science night we have done prior. We have contacted them, however, as of 1/31/2020, we have not received a reply.