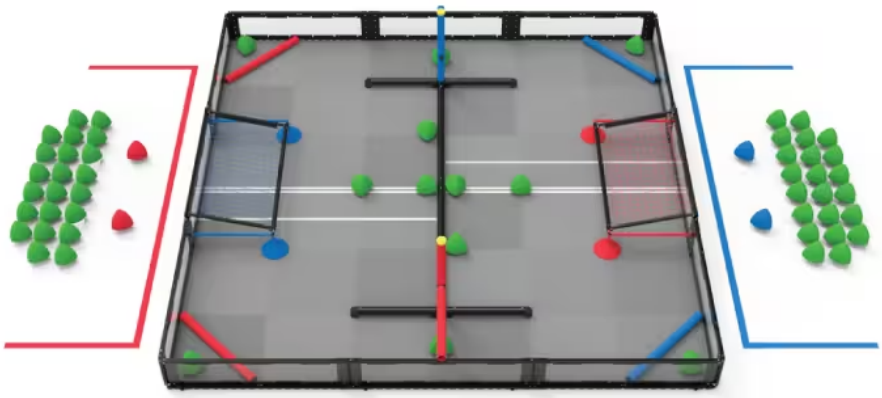
Engineering Notebook

Team 53B



Over Under

2023 - 2024

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Notebook Workflow

Why Digital?

Last year, our notebook workflow was very disorganized and pushed most of the work onto one team member. Not only was this unfair, it also meant that our notebook was not the highest quality and one person was doing more work than they needed to. So this year, we have decided to do an all virtual notebook, where entries are written by all the team members, and the "notebooker" is the one formatting them.

How does it work?

The way our notebook process works is that team members will write entries in a shared google doc, while not having to worry about formatting, making it a lot quicker. Then, the notebooker will copy entries from the google doc and format them in typst, which is a LaTex-like coding language for creating documents. Then, another member will print out the pages and put them in our notebook binder.

Typst?

Typst is an open-source document language written in rust that offers many powerful features for advanced writing. Typst has many useful tools, such as better math handling, better organization and consitency, while also allows users to create their own templates and functions.

Defining custom function:

```
// file: /templates/headers.typ
#let box_header(title: [], color: luma(230)) = {
    box(
        fill: color,
        radius: 2pt,
        inset: 6pt
    )[
    #text(
        size: 16pt,
        [=== #title]
        )
    ]
}
```

Using custom function:

```
#import "/templates/headers.typ": box_header // import from template file

#box_header(
    title: [Custom Functions with Typst!], // sets the title
    color: blue.lighten(75%) // sets the color
)
```

This would create:

Custom Functions with Typst!

Understanding Colors

This notebook uses color coordination to represent who sections were written by or who they highlight, as this allows us to visualize how the work is being shared. Below is a reference table with each color and its respective meaning.

Blue	**Gabriel**
Yellow	**Jin**
Purple	**Deb**
Red	**Imaad**
Green	**Juan**

Team Members

Gabriel Cruz

- 12th Grade
- Team Lead
- Programmer
- First Season: Tipping Point

Jin Hao Cao

- 11th Grade
- CAD Specialist
- Builder
- First Season: Tipping Point

David Blaufuss (Deb)

- 11th Grade
- Builder
- Notebooker
- First Season: Spin Up

Imaad Azeem

- 10th Grade
- Driver
- First Season: Spin Up

Juan

- 10th Grade
- Builder
- First Season: Spin Up

Spin Up Reflections

Networking

We've discovered that one of the most effective ways to learn is through engaging conversations with teams from diverse regions. Despite not qualifying for the world championships, a golden opportunity emerged at the US Open when we had the chance to connect with a remarkable team that would eventually make it to the top 8 teams at Worlds: team 2775V. Their insights were invaluable, and they introduced us to their ingenious creation – the JAR Template. The template includes everything needed in the programming aspect, from PID to Odometry. The best part is that it is compatible with Vexcode V5 Pro, which most are not. It was also great to learn about how they approach alliances, prepare for matches, and their communication in the driving pit.

Gabriel with members of 2775V at US Open

Cad

Last season there was a concern regarding the lack of designing and planning in the club. The coaches noticed that the team was building robots blindly and recommended spending some independent time creating CADs before starting to build. The benefit of creating a CAD design for a drive-train before attempting to physically create it is that it allows for freely changing the spacing of the gears to get it correct and as compact as possible. Below is a prototype of a 6 motor drive, which the team might plan to recreate. The drivetrain uses a 3:5 ratio, 3 ‘25 omni wheels, and an RPM of 360.

Driving

Last season, we realized the importance of consistent and sufficient practice for our driver to perform at their best. While we faced challenges in tournaments due to inadequate practice time, we have learned from this and are taking a new approach this season. As the current driver, I have prioritized practicing fundamental skills, such as maneuvering around obstacle courses, to improve my driving abilities. By tracking my progress and regularly practicing, I am confident that I will be able to compete at a higher level and contribute to the team's success in this season.

Team Efficiency

Throughout last season, our team's performance in Vex Robotics tournaments suffered from a lack of efficiency. As the new lead of Team 53B in our upcoming competition, I recognize the importance of adhering to Akin's Law of Spacecraft Design. This principle emphasizes the value of simplicity, avoiding unnecessary complexity, and focusing on essential tasks to increase efficiency and productivity.

Thanks to our coach, we have embraced Akin's Law as a valuable framework for our Vex Robotics process. Before designing and building our robot for the new game challenge, we have made sure to do the necessary math and physics calculations, especially for climbing the pole. As the lead programmer, I am testing our code to ensure its reliability and efficiency.

David, our builder, is following Conway's Law, which advocates for organizing teams based on the system they are designing. By working closely with Jin, our CAD specialist, David ensures that our robot is built in a modular and cohesive way. This approach makes it easier to maintain and modify our robot during the competition.

Immad, our driver, is following Murphy's Law, which anticipates and prepares for the worst-case scenarios. By thoroughly testing the robot's programming and drivetrain's reliability, Immad is ready to handle unforeseen circumstances and make quick decisions during matches.

Juan, our scout, is following Pareto's Law, which prioritizes the most impactful data. He is gathering and analyzing key information to inform our strategy for each match, maximizing our scouting efficiency.

As a team, we are committed to notebooking and documenting our progress and lessons learned. By following Akin's Law of Spacecraft Design, Conway's Law, Murphy's Law, and Pareto's Law, we are working together cohesively to achieve success in our upcoming Vex Robotics competition.

Organization

Last season, organization was a big problem for our team. Things were constantly getting lost, and it created many situations where we had to compromise. This year, I want to have an emphasis on organized workflow, as well as more organized operation of the bot. One change we have decided to make is making our notebook virtual. This allows work to be split a lot easier, and prevents one member from being overwhelmed.

Name Reveal: Over Under

April 22nd, 2023

Gabriel

When the game, “Over Under”, was first announced I thought that it would follow Vex’s usual cycle of games, meaning that the game will involve stacking. However, now I think that the robot will have to do more with moving through obstacles efficiently.

Deb

Given the name of the game, I think this game would involve stacking of some form. I think we will have to stack things over others, and maybe have to put objects under platforms. I think the game objects will have cubes, similar to the ones from Tower Takeover.

Jin

Considering that we haven’t had a stacking game since Tower Takeover, I predict that we will be getting some sort of a stacking game. I think we need to construct a bot that will stack things over a hill like a King of the Hill. Lastly, the bot needs to park under something.

Immad

When I heard ”Over Under” I guessed that we would have to either maneuver over obstacles or move game objects under and over a bar. I thought we would have to focus on the size of the robot because there would probably be a lot of obstacles.

Juan

When I heard the name “Over Under” I thought of a game involving moving blocks. I believe that this season will result in a game where we have to move our bot over obstacles. We might also need to move objects into slots.

First Meeting After Reveal

April 28th, 2023

Gabriel

After the reveal was released, I instantly thought of the importance of a small drivetrain, i.e 25-30 holes long, this is so that you can easily maneuver under the objects even if someone were to block the path. To add on to the drivetrain, I think it's important to be able to drive over the middle bar, so 4-inch wheels should be used this season. As for the RPM of the drivetrain, I think it should be circa 350 rpm. Also, the fact that there are more game objects that are match load-ins it is important to fastly place and shoot from the match load area. The way I think this is possible is by using a puncher that will be ratcheted to the intake for fast cycle times. For the endgame phase of the match, I think a piston that attaches to the pole and a motor connected to wheels to move up the bar will maximize points. Another good idea I thought of could be to pick up your alliance and carry them, since the points are relative to the highest point. Also, the new introduction of the watt limit is interesting.

Deb

After watching the reveal, I immediately thought of a bot that would push the acorns into the back of the goal. This robot would have a puncher to do that, and that would also be able to launch the acorns to the other side of the field. I also thought about making a piston that would lift the front wheels which would allow us to go over the three inch pipe in the middle. Overall, my first impressions of this game are rather positive, and I think that it looks like fun.

Jin

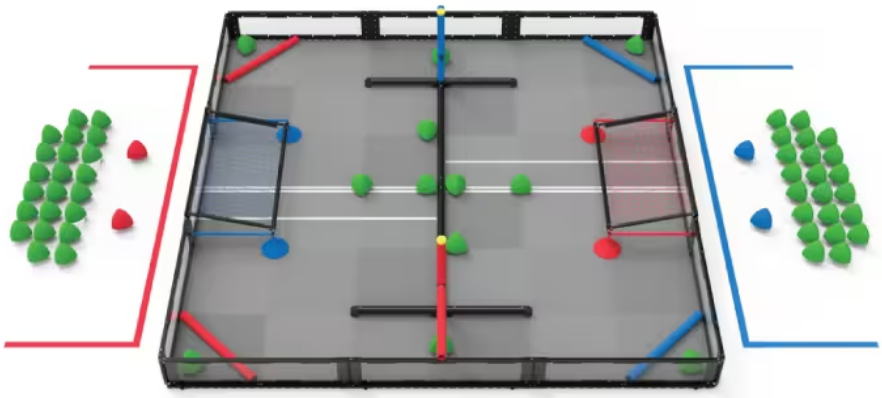
Something in the video that surprised me was the hanging aspect of the game. Never have I thought we would need to make a robot capable of holding onto a bar. One of the biggest concerns was what will happen after the game is over and all the motors go into coast mode. My idea for this problem is to make a 4 bar which I believe could be strong enough to hold the weight of the bot. We would open the clamp with motors, so when the motor dies at the end of the game, we will remain hanging.

Immad

When I watched the video I was intrigued with the grabbing aspect of the game because it would lead to a lot of different methods of picking up the acorns . Some ideas I had that are pretty interesting are a claw bot which would have a lot of maneuverability or a bot that scoops up the triballs and punches them into the goals. As a new driver this game seems harder than last year's Spin Up since it seems to focus on more of a skill oriented driving style instead of an aggressive style.

Juan

After watching the reveal I was surprised to learn about the pole-climbing aspect of the game. A problem we may need to focus on is how to get the bot off the pole safely. We could make something that clamps onto the pole using motors to "drive" up the pole. Overall, I believe this will be an interesting season allowing for creative/innovative ideas.



- VEX Robotics Competition Over Under is played on a 12’ x 12’ square field configured as seen above.
- Two (2) Alliances – one (1) “red” and one (1) “blue” – composed of two (2) Teams each, compete in matches consisting of a fifteen (15) second Autonomous Period, followed by a one minute and forty-five second (1:45) Driver Controlled Period.
- There are sixty (60) Triballs on a VRC Over Under Field.
- There are two netted Goals on opposite sides of the field. A 3” PVC Barrier divides the field into a Red Offensive Zone and a Blue Offensive Zone.
- Each Triball scored in a Goal is worth five (5) points, and each Triball which makes it into an Offensive Zone is worth two (2) points.
- The VRC Over Under field also includes two sets of Alliance-specific pipes on either side of the Barrier. These are called Elevation Bars, and are used at the end of the Match for Elevating Robots.
- At the end of the Match, each Robot’s height off the ground will be measured to determine their Elevation Tier. Elevation Points will then be awarded based on each Robot’s Tier relative to all other Robots. For example, getting to Tier E could be worth as many as twenty (20) points OR as few as five (5). Elevation Tiers begin at the floor, and they end above the Elevation Bar!
- The Alliance that scores more points in the Autonomous period is awarded with eight (8) bonus points, added to the final score at the end of the match. Each Alliance also has the opportunity to earn an Autonomous Win Point by completing three assigned tasks. This Bonus can be earned by both Alliances, regardless of who wins the Autonomous Bonus

Goal	Points
Autonomous Bonus	8 Points
Each Triball Scored in a Goal	5 Points
Each Triball Scored in an Offensive Zone	2 Points
Elevation - Top Tier	20 Points
Elevation - 2nd Tier	15 Points
Elevation - 3rd Tier	10 Points
Elevation - 4th Tier	5 Points

Computer Aided Design

Summer Break

Introduction

Computer-aided design, commonly referred to as *CAD* is the process of creating a design with computer software. This allows an engineer to visualize and simulate their design without spending resources to build a prototype. Last year, we did not utilize CAD in our design process, which often meant that many of our designs never worked, causing a lot of delays. This year however, Jin decided to take the initiative and learned how to design a robot using Onshape, a popular web-based CAD platform.

Learning Onshape

Jin will explain the process here