



Citrus Circuits
Fall Workshop Series

Subsystems 101-678

by Dave Powers and Brendan R.

Who are we?



One of my best friends, Max and I, Champs 2022.

- David Powers
 - Engineering Manager at AFT
 - Hardware and Design Mentor at 1678
 - 14th year in FRC
 - 22nd year around FIRST



Who are we?



- Brendan R.
 - 3rd year in FRC
 - Design Lead on 1678
 - Most important thing brendan has learned from FRC? “How to work in a professional environment and use CAD software...”



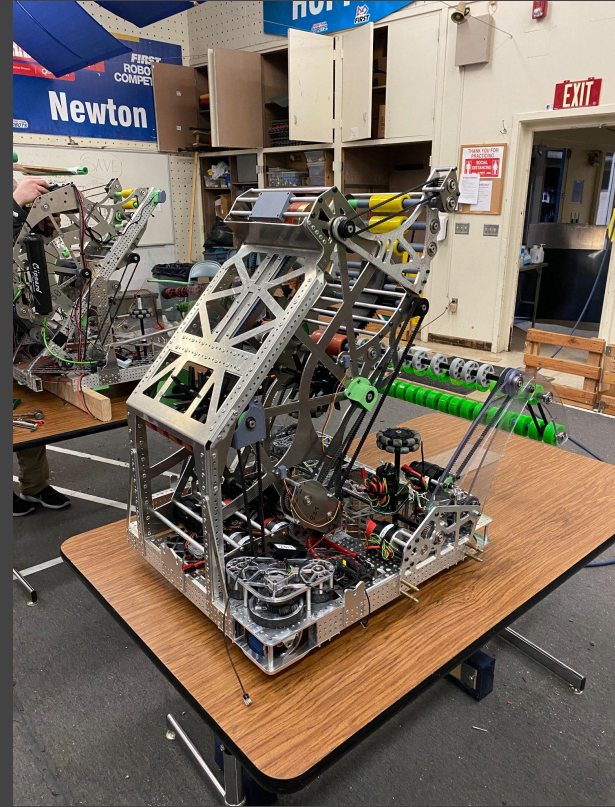
How about some context please

- Going to do a little case study and review the hopper from the 1678 2022 robot.
- Share tips and tricks on how to speed up the process of development.
- Share personal bits from the season we've never shared before.

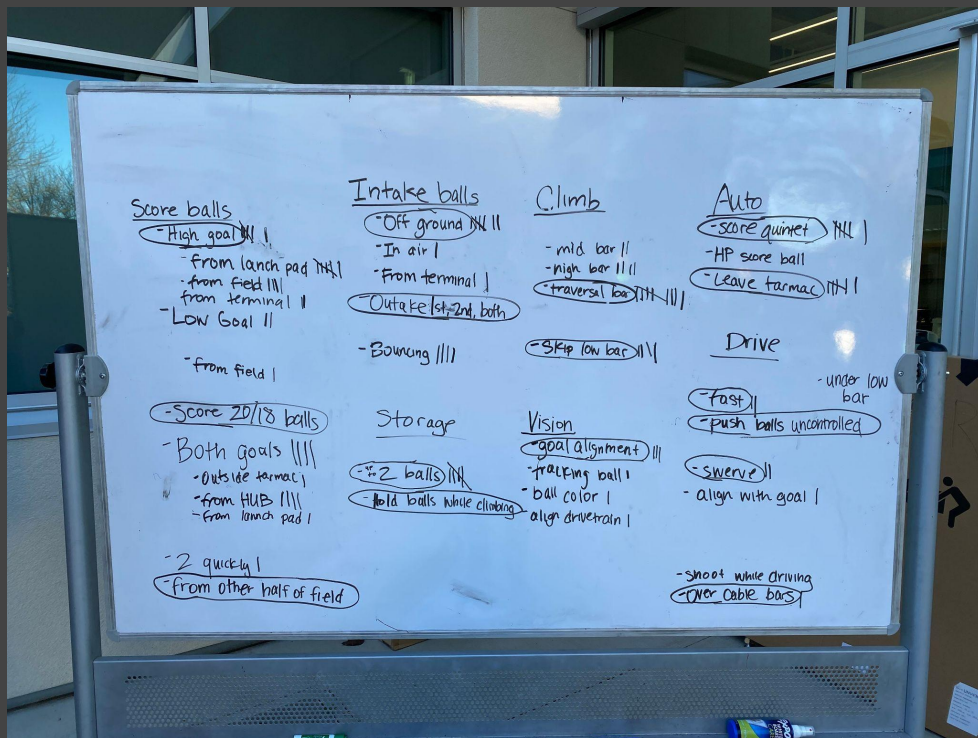


The Hopper

- Major Design Requirements
 - Dual use hopper
 - Ball storage and sorting
 - Automated
 - Simple
 - Reliable
- How did we get here?



Where did we start?



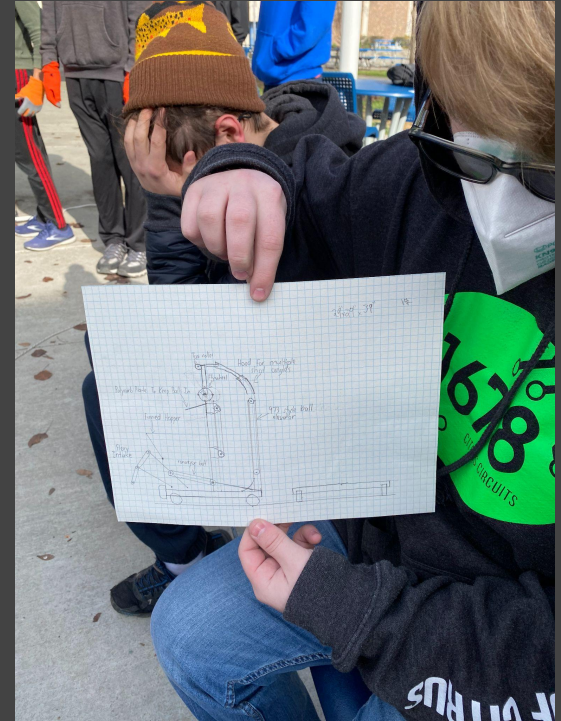
- Hold 2 balls
- Hold Balls while Climbing (???)

Break out the history books

- Used our brains and the internet to think back to effective simple mechanisms from the past.
- We just want to build the lowest effort, first prototype to see how the game pieces interact.
- Everyone sketch some robot ideas!

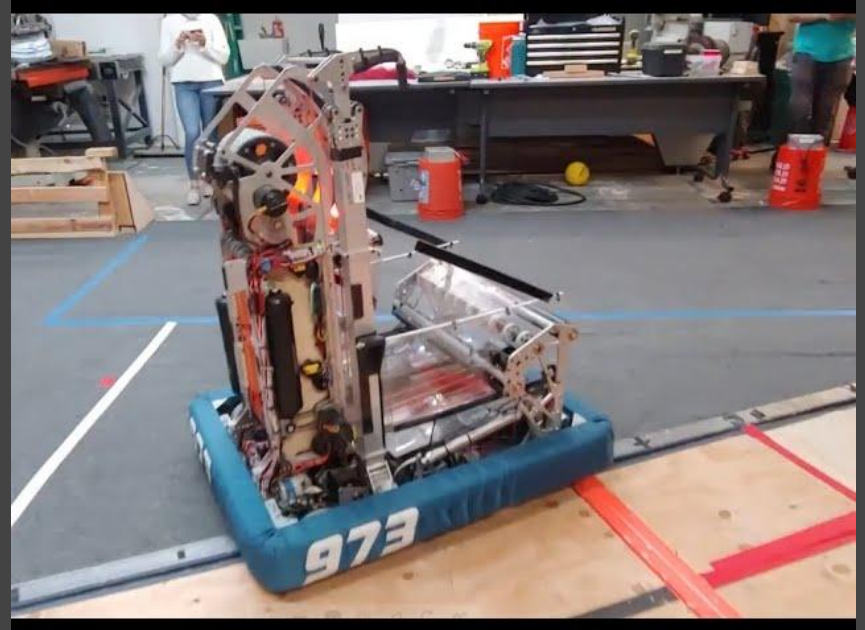


Drawing Time



Quick Low Effort Prototypes

- Base these on old robots
 - 973 2020 Hopper
- Rip it as quick as possible
 - Hands on to see how the game pieces react in subassemblies
 - You can build many of these!

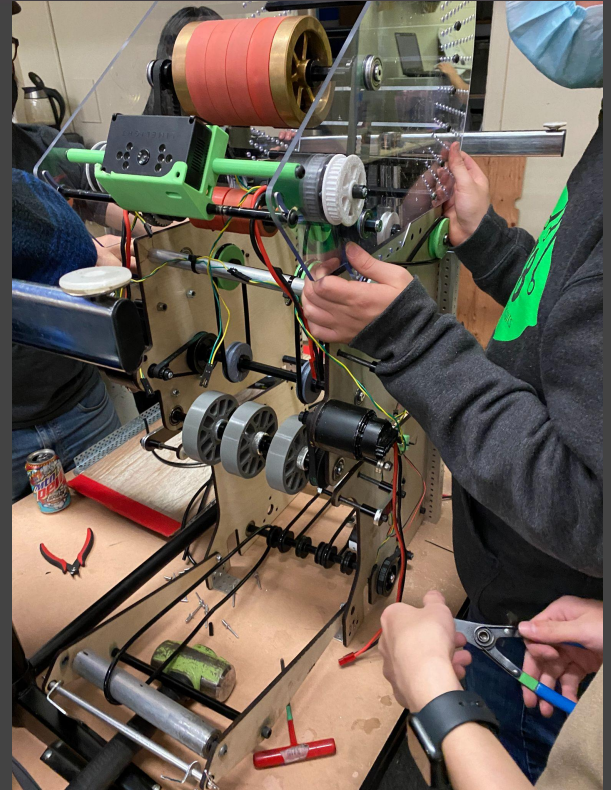


Quick Low Effort Prototypes



Find the failure points

- Some learning
 - Proper C-C needed to support game piece traveling
 - Speeds
 - Additional pieces needed to support (feeder wheel)



Understand limitations and adjust

- It's hard to know your limits, but makes the world of a difference.
- Support yourself in discovery, give it enough time
- Make a list of the reasons why it's good, and it's bad
- What else can we get out of this? (ideas started turning about sorting)



Research



Build a better one

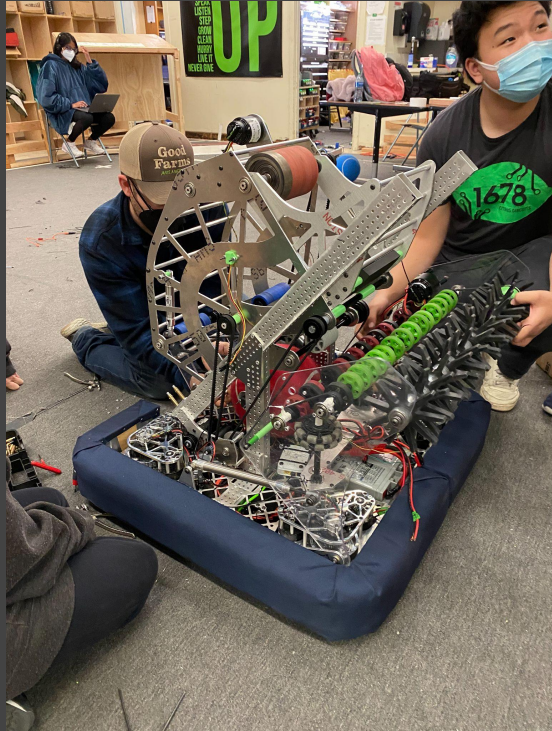
- Rescope
 - Build a more solid one
 - Integrated better
 - More capability
- Doesn't need to be a beta robot
- Make it good enough to practice with
 - Hours not minutes



Build a better one



Build a better one



Practice Practice Practice

- Hours not minutes
- Real match situations
 - Do your best to simulate real things your subsystem will see in a match
- Break the damn thing!



Be honest with yourself

- You're not doing yourself any favors
 - It's hard, that's okay
- Evaluate issues
 - Failing is learning!
- Don't be afraid to scrap it and start over



Adapt and overcome

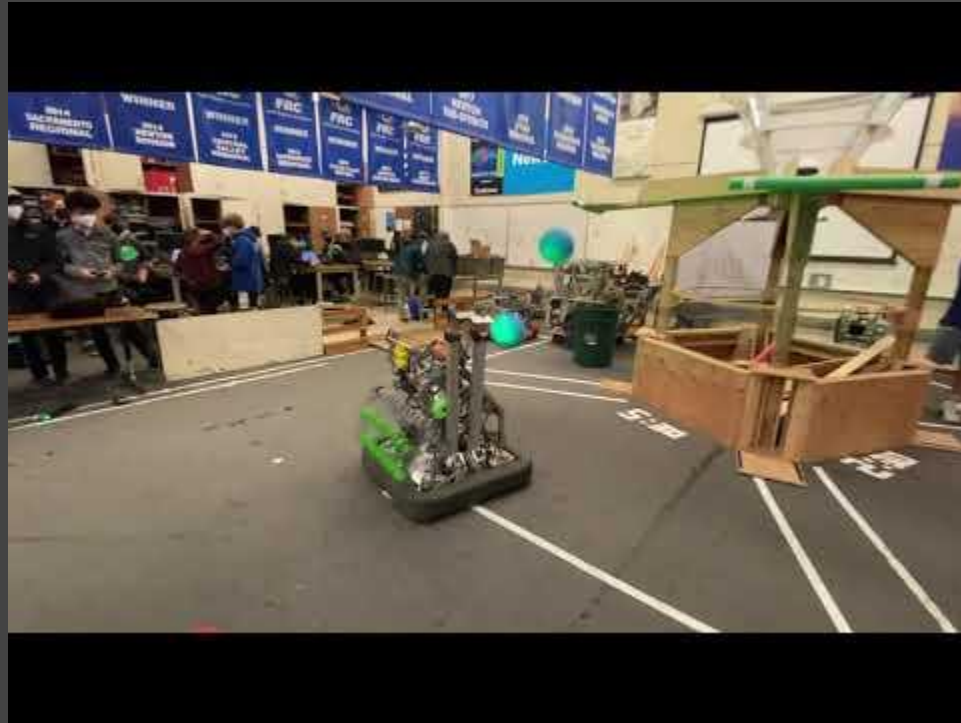
- The flap didn't work, what else can we try?
- Go back to an earlier step
 - Low effort prototypes
 - Old robots
- Find the next promising task
 - Build one better
 - Practice



Adapt and overcome



Good enough? Good enough.



Continue your development

- No reason to stop
 - Keep going through the cycle
 - The more practice, the fast the cycle gets, the better the robot gets
- Only bit to remember, prioritize
 - Good enough? Good enough.
- Push yourself
 - "Once you know what failure feels like, determination chases success."

-Kobe Bryant



Final Questions?





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Thank You!