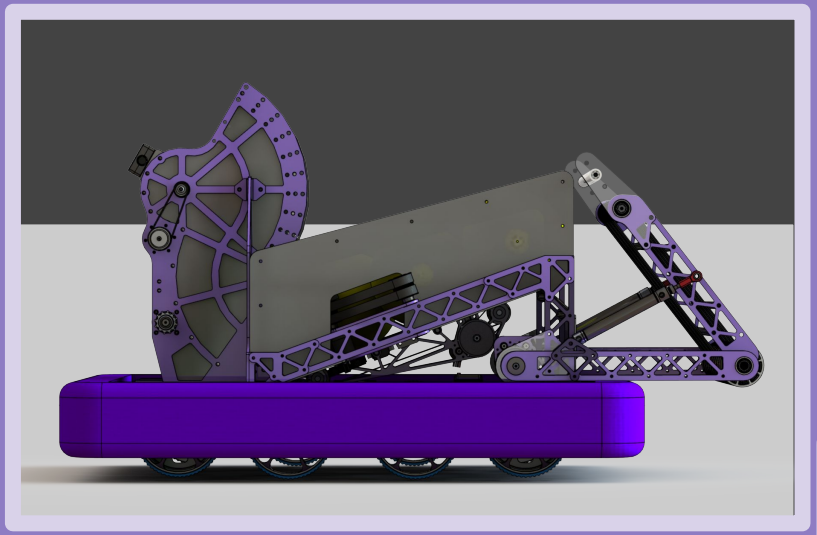
CyberTooth 3940

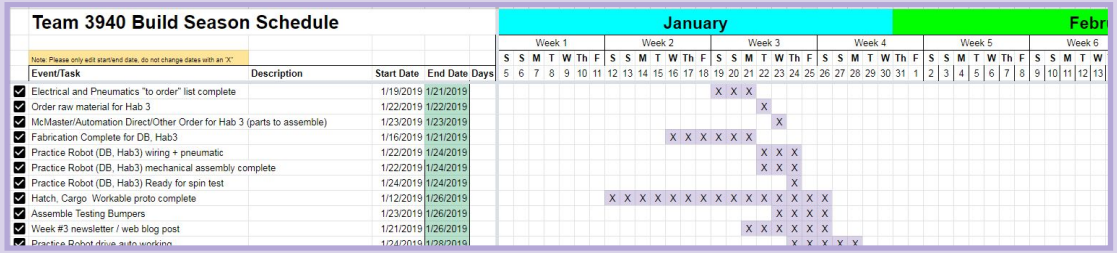
2021 Robot Design and Process



Build Season Process

Build Timeline: CyberTooth uses a strategic design process to plan out the whole robot before final fabrication. Below are the basic steps the team goes through during the build and competition season.

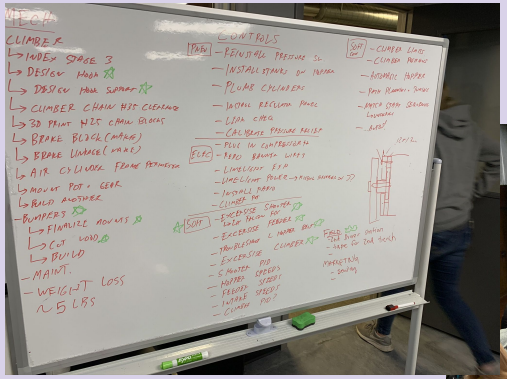
Specific Timeline: One of the main issues identified in previous seasons was not finishing the robot on time. For the 2020 robot, a detailed Gantt Chart was used to stay on track and make sure the robot was finished on schedule.



Build Season Process

Resource Tokens: CyberTooth uses the concept of resource tokens to help balance robot build aspirations and team resources. Resource tokens are a unitless number to measure our ability to “do the thing” based on team abilities such as:

- Available student time
- Available mentor time
- Machining capabilities
- Component inventory
- Financial assets
- Design and Controls skills and talent
- Previous experiences



Like all teams, CyberTooth has a finite number of resources to produce an attractive and competitive robot for the season; and we strive to make the most out of the tokens we have. This system also keeps us in check, and pushes us to find and execute simpler solutions for mechanisms without significant compromises to our priority list.

Build Season Process

2020 Robot in a Sentence

- A short guiding description of what our robot is going to do.
  - **2020**: “Short robot that maximizes Power Cell scoring in autonomous and teleop, with a consistent climber.”
- Ensures team is on the same page as far as what kind of robot we are aiming to build.

Ability and Priority List

- Expanded list of things the robot and individual mechanisms will do and the qualities they will have based on our competitive goals for the season.
- This list is used to drive what kind of mechanisms we build and what they will do.
  - Example: if sideways movement of the robot is not needed, we won’t build a drivetrain that has this ability.
- Revisit this list throughout the season to make sure robot stays on track to reach our goals.

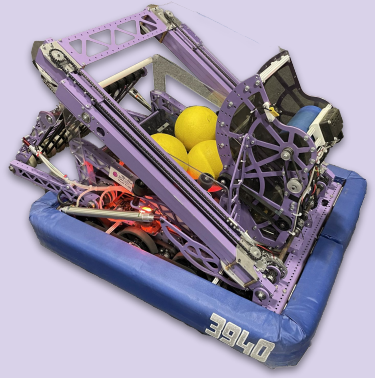
Section	Ability	Must have for District Events	Nice to have for District events	Maybe States or Worlds?	Not Important
Drive	Drive on Carpet	X			
	Drive over Steel Bars	X			
	Drive through Trench	X	X		
Power Cells	Hold 3 balls in AUTO	X			
	Hold 5 balls in AUTO	X			
	Hold 5 balls in TELEOP	X			
	Pick up from floor in TELEOP	X			
	Pick up from alliance station directly		X		
	Pick up from floor in AUTO	X			
	Score in the OUTER PORT AUTO	X			
	Score in the OUTER PORT TELEOP	X			
	Score in the INNER PORT AUTO	X			
	Score in the INNER PORT TELEOP			X	
	Score in the BOTTOM PORT AUTO				X
	Score in the BOTTOM PORT TELEOP				X
	Deliver to partner		X		
	Outtake		X		
	Score 3 in Auto	X			
	Score 4 in Auto	X			
	Score 5 in Auto		X		
	Score 6+ in Auto		X		

CyberTooth robotics team

2021 Process Modification

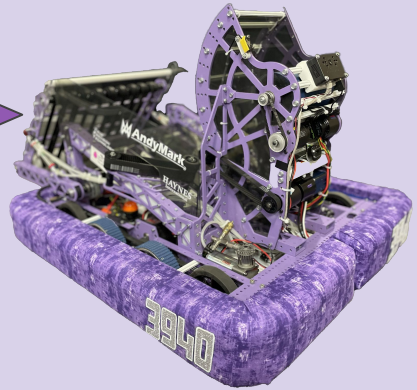
2020

Kickoff → Game Analysis → Robot in a Sentence → Priority List → Prototyping → CAD → Fabrication → Assembly → Testing → Comp[illegible]ition → R[illegible]ew



2021

Kickoff → Challenge Analysis → Priorities → Re-evaluate each subsytem → CAD → Fabrication → Assembly → Testing → Challenges



CyberTooth did not compete in any 2020 events. We chose to take our 2020 robot, re-evaluate it, and modify it for the at home challenges.

CyberTooth robotics team

Key Takeaways for 2021

Infinite Recharge at Home Challenge Analysis

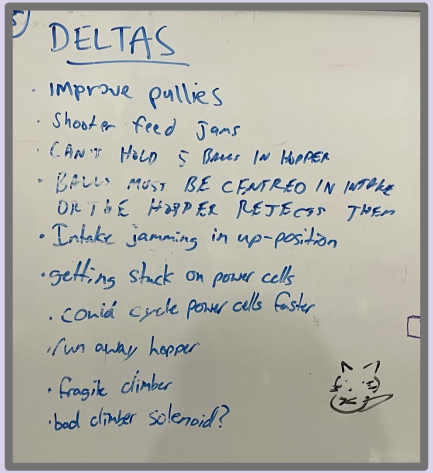
- No climbing
- No defense
- Need agility and precision for driving challenges
- Need accuracy in shooting for Interstellar Accuracy
- Need speed for Power Port and Hyperdrive

Resources for 2021 Limited Compared to 2020

- Smaller team
- Younger team
- Risk of meeting cancellations
- Limited programming mentorship

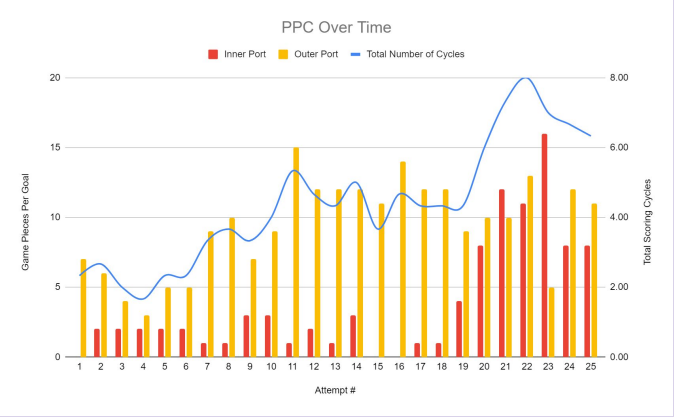
Positive Resources

- Access to practice field
- Manufacturing and CAD Mentor support
- Meeting in person
- Focused pre-season on driver practice



2020 Robot Baseline Data

- Before making changes to the robot, the team established a baseline of data to ensure changes made to the robot were leading to improved performance in the challenges.
- Practice was important to improving results, but the team felt additional changes to the robot would also help to improve performance.



Baseline (No mods to Pegasus)									
Attempt #	Zone	Bottom Port	Outer Port	Inner Port	Score	# of Game Pieces	OAL Accuracy	Inner Port Accuracy	Notes
1	Green	0	0	0	31	12	80.00%	58.33%	2D Goal, no Green Zone Attempts, single ball attempt
	Yellow	0	1	2					
	Blue	0	1	5					
	Red	0	3	0					
2	Green	0	0	0	30	12	80.00%	50.00%	2D Goal, no Green Zone Attempts, single ball attempt
	Yellow	0	0	3					
	Blue	0	4	2					
	Red	0	2	1					
3	Green	0	0	0	34	12	80.00%	83.33%	2D Goal, no Green Zone Attempts, single ball attempt
	Yellow	0	0	3					
	Blue	0	0	6					
	Red	0	2	1					
4	Green	0	0	0	32	12	80.00%	66.67%	2D Goal, no Green Zone Attempts, single ball attempt
	Yellow	0	2	4					
	Blue	0	0	3					
	Red	0	2	1					

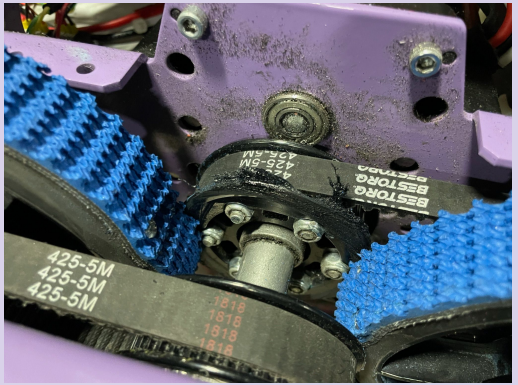
Pegasus 2.0: *Drivetrain*

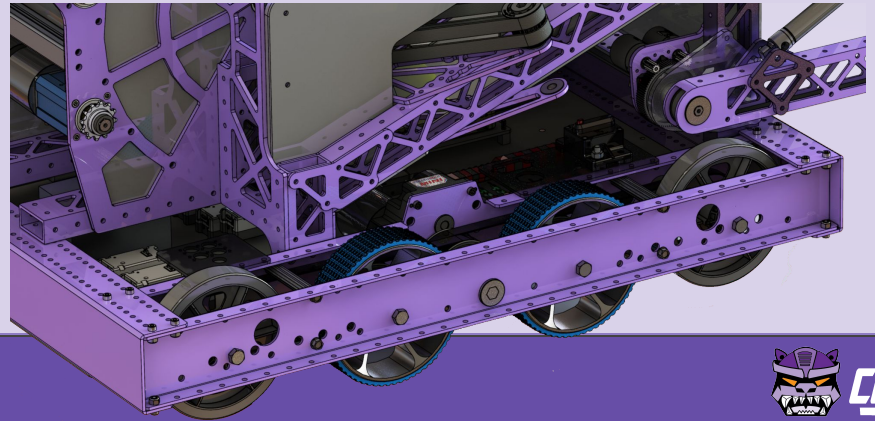
Motor Changes

Brushed CIM Motors → Brushless NEO Motors

Wheel Changes

8WD Black Smooth Grip → 8WD Combination Smooth Grip and Blue Nitrile Treaded Center Wheels





More grip on wheels for better control and faster acceleration.

Brushless motors have increased drive power - needed more grip to compensate.

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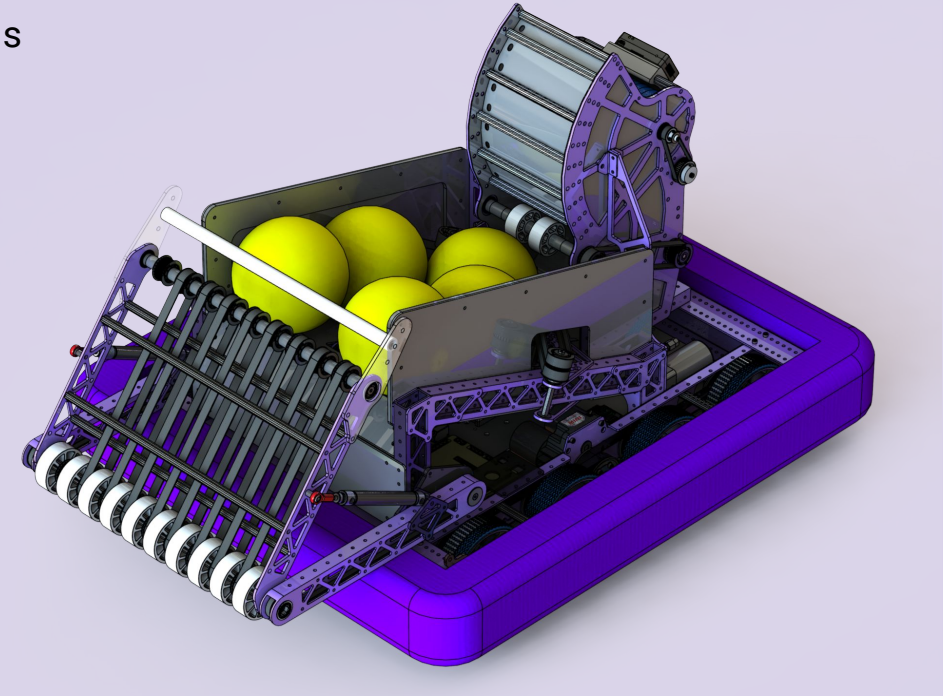
Pegasus 2.0: *Intake*

How it works: Belts and wheels bring Power Cells from floor to Hopper.

- 3D printed crowned timing pulleys to keep belts aligned
- Timing belts maintain their length for minimal belt maintenance
- Pneumatic flap for deployment and anti-jamming
- Belt-in-tube powertrain protects moving parts
- Uses bumpers and battery shield to pull Power Cells into hopper
- Custom white compliant wheels from injection molding sponsor B&D



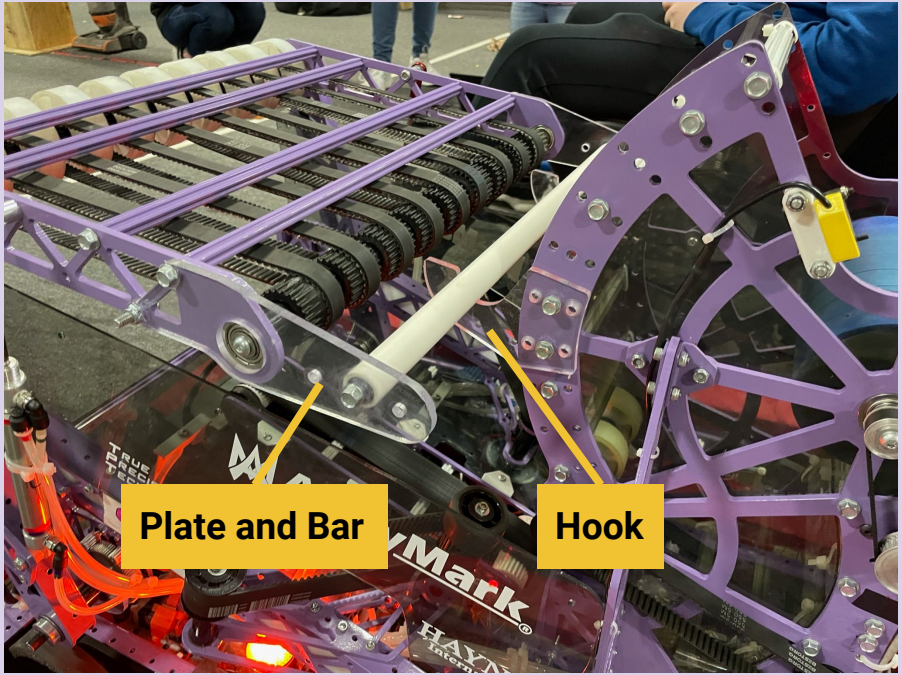
Pegasus 2.0: *Intake*

“Anti-potato” plate and bar

- Keep Power Cells from jamming
- Fewer “rejections” - dropped Power Cells
- Keeps Power Cells in the hopper

Hook

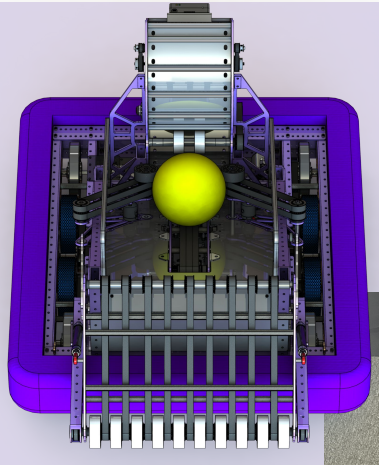
- Keeps intake inside frame perimeter
- Allows Power Cell processing with intake up
- Works with new bar

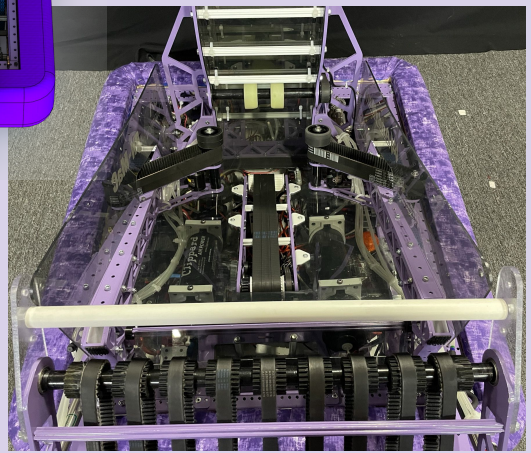


Pegasus 2.0: *Hopper*

How it works: V-belt configuration brings Power Cells quickly through robot from intake to shooter.

- Open top for easy loading
- Slanted base to utilize gravity for faster processing
- 3 feeder belts run at different speeds to serialize Power Cells and prevent jamming
- Banner retro reflective sensors sense Power Cells and tells belts when to run
- Runs forwards and backwards to prevent jams

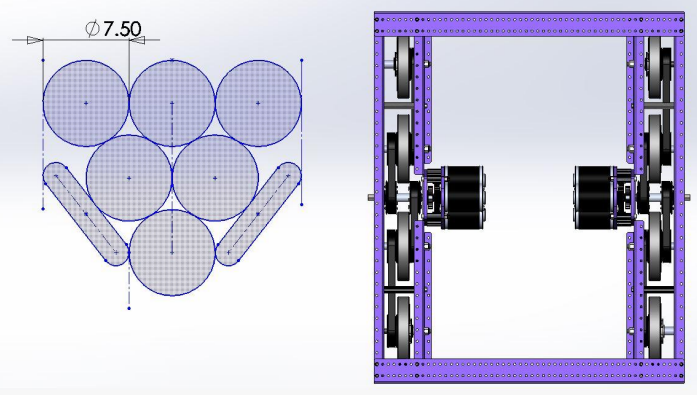


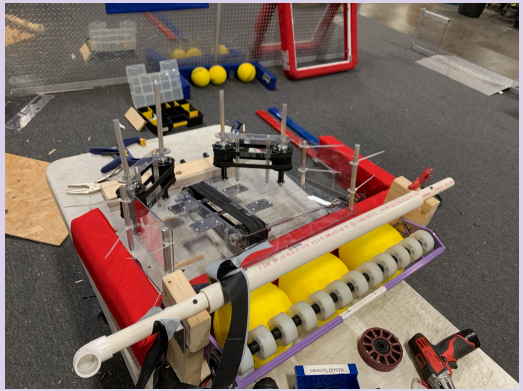


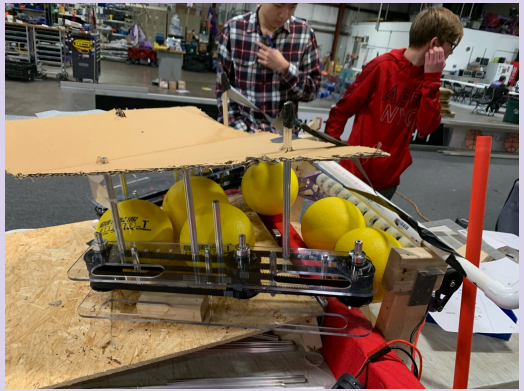
Pegasus 2.0: *Hopper*

The team learned from previous experience that internal game piece processing has been difficult, and needed to be a priority to optimize for INFINITE RECHARGE.

We prototyped this mechanism the most going into 2020. Minimal programming changes were made for 2021 to increase belt speed and optimize processing time.



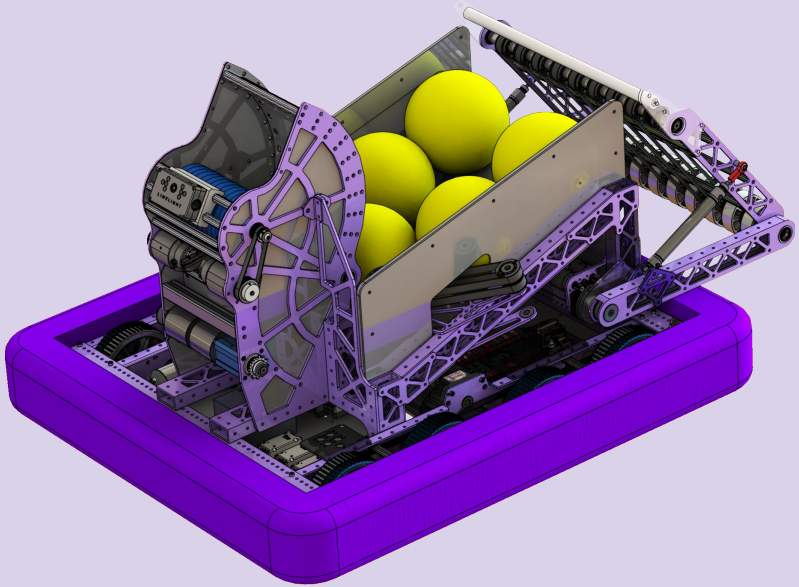




Pegasus 2.0: *Shooter*

How it works: High-powered, dual brushless driven flywheel hooded shooter.

- Built for consistency & quick throughput
  - Solid, smooth stealth wheel array
  - Long S-path, maximum shooter wheel contact
  - Smooth polycarbonate lined inner surfaces
- Lower feed wheels stage Power Cells until shooter wheels are up to speed to ensure shot consistency
- Uses encoder feedback to wait until shooter wheels are up to speed.
- Rigid construction, securely mounted to frame structure
- Shooter hood has built-in adjustability to accommodate different Power Cells
- Integrated mounting for Limelight and camera



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Thank you!
Questions?