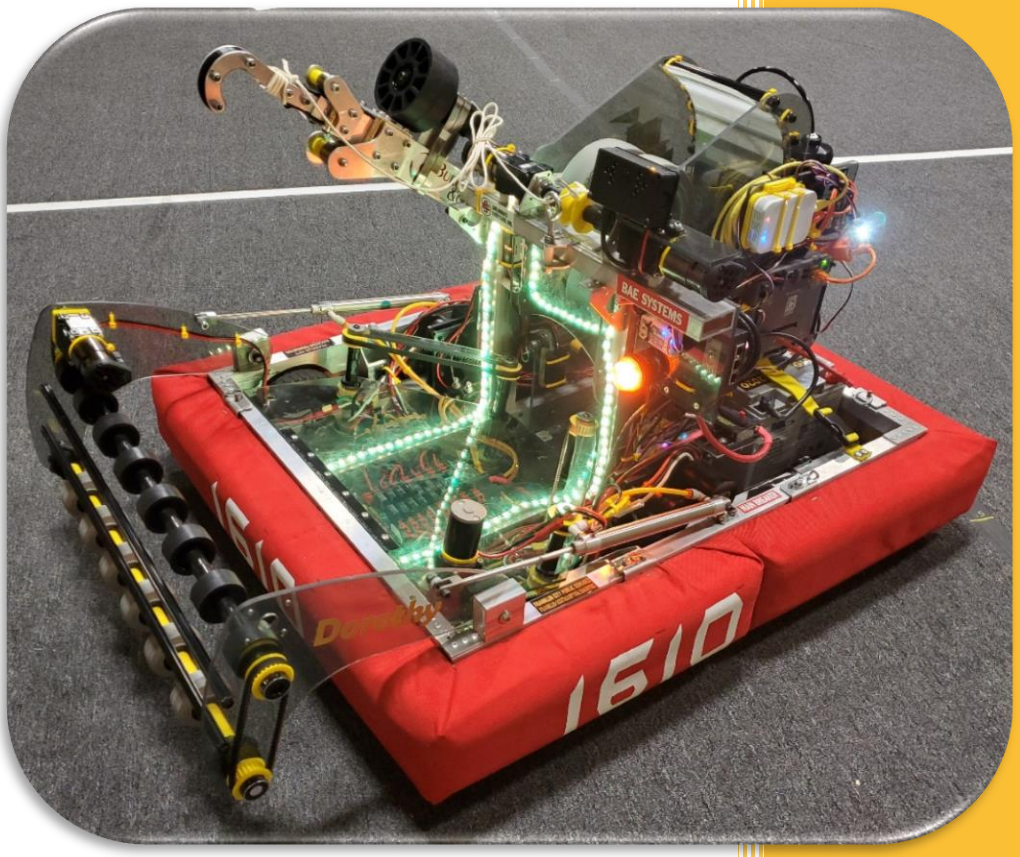
2020

“Dorothy” Technical Binder



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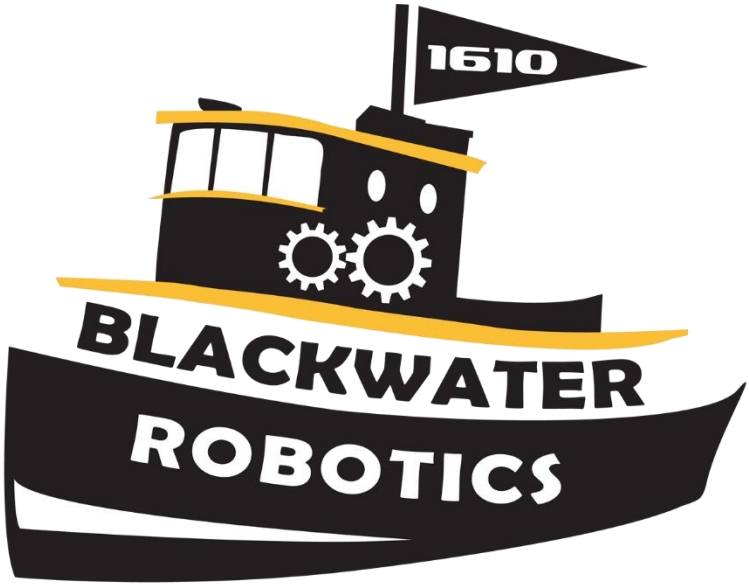
BLACKWATER ROBOTICS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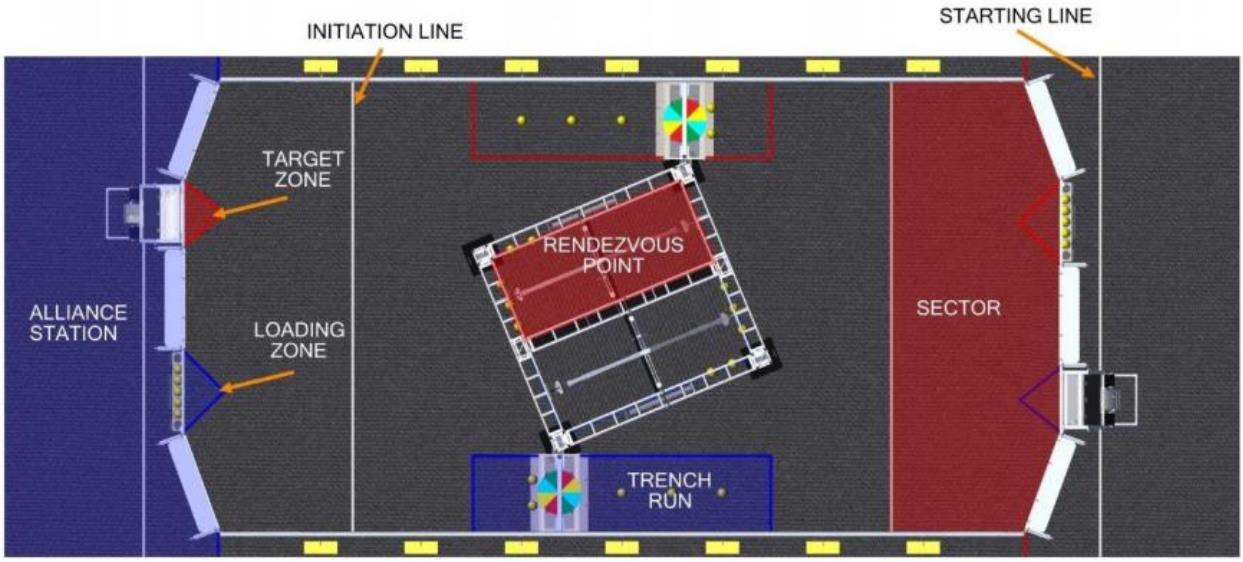
GAME ANALYSIS



Award	Awarded for…	AUTO	TELEOP	Qual.
INITIATION LINE	exit the infinite vertical volume created by the corresponding ALLIANCE'S INITIATION LINE any time before the end of AUTO (per ROBOT)	5	-	-
POWER CELLS	scored in BOTTOM PORT	2	1	-
	scored in OUTER PORT	4	2	-
	scored in INNER PORT	6	3	-
CONTROL PANEL	ROTATION CONTROL	-	10	-
	POSITION CONTROL		20	
ENDGAME Points	HANG (per ROBOT)	-	25	-
	PARK (per ROBOT)	-	5	-
	LEVEL with 1-3 ROBOTS HANGING (per ALLIANCE)		15	
SHIELD GENERATOR OPERATIONAL	earning at least sixty-five (65) ENDGAME points			1 Ranking Point
SHIELD GENERATOR ENERGIZED	Stage 3 ACTIVATED	-	-	1 Ranking Point
Tie	Completing a MATCH with the same number of points as your opponent	-	-	1 Ranking Point
Win	Completing a MATCH with more points than your opponent	-	-	2 Ranking Point

Infinite Recharge

Infinite Recharge brings back a somewhat familiar game piece, the foam ball, just in a different size and texture, paired with a climbing endgame complete with tilting bar and a Trench that could impose a height limit if you don't want to be cut off from part of the field. Consistent scoring and a reliable climber will be the keys to our success this season.

On the second day of build season we invited local teams to our shop to discuss game strategy and play a "human game." These scenarios helped the teams in attendance to see how a full 3 vs 3 match might play out.

Visiting teams gather to discuss gameplay and strategy for the 2020 season.

Through using different scenarios to play simulated matches, we came to some conclusions:

- Endgame climbing points will be critical and the deciding factor for many matches.
- Shape an orientation of the truss will make field traversal less than optimal. This adds value to a robot <28" in height to pass through the Trench.

Build and Game Strategy

Our top priority is to rank as an alliance captain by winning matches and gaining extra Ranking Points. The two extra ranking points are available when:

- At least two robots climb and balance
- At least 49 Power Cells are scored and Control Panel is activated at appropriate stages

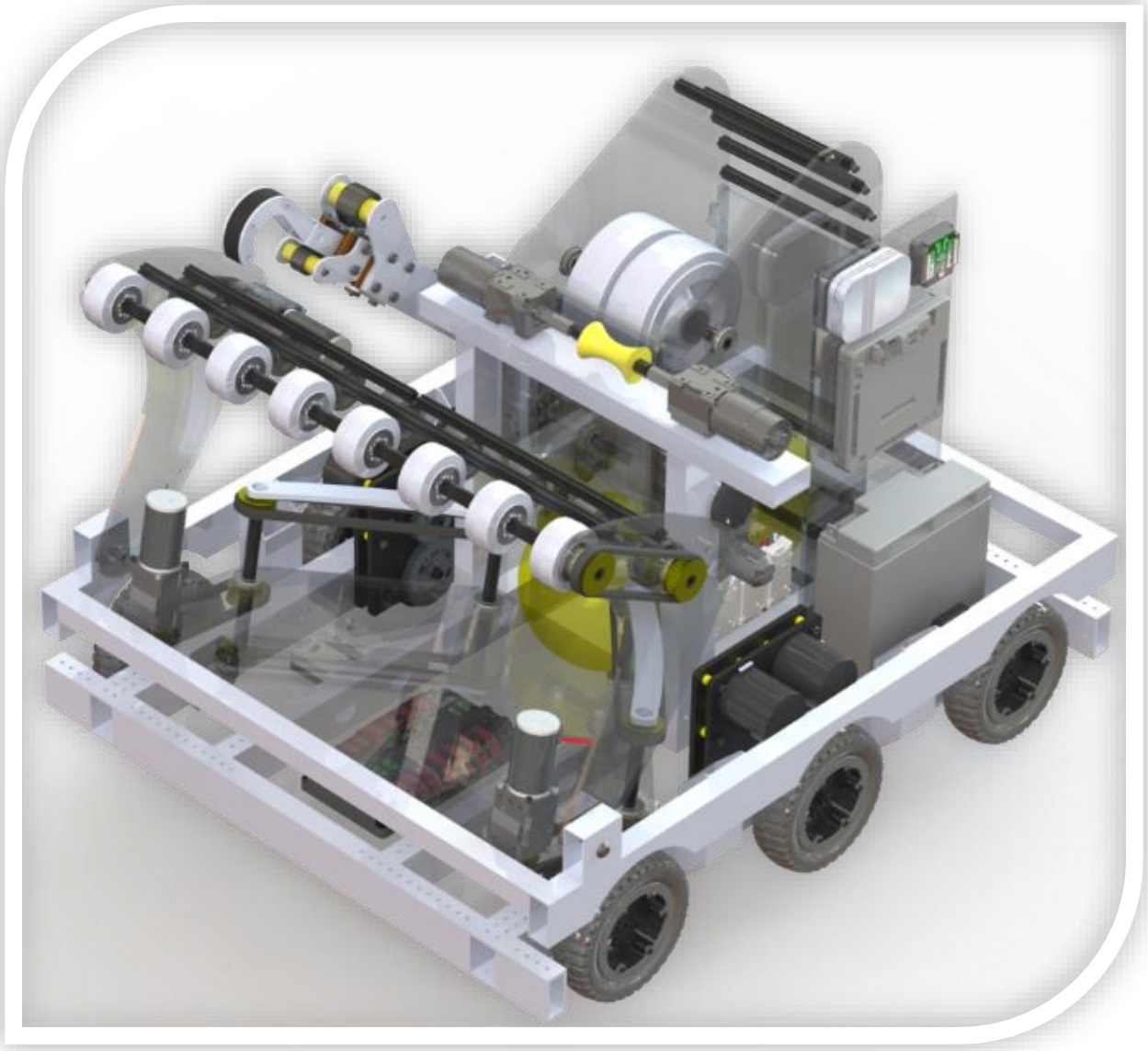
Therefore, we made three main design decisions:

- Must score Power Cells consistently
- Must climb for Endgame
- Must be able to manipulate Control Panel

Design Priority List

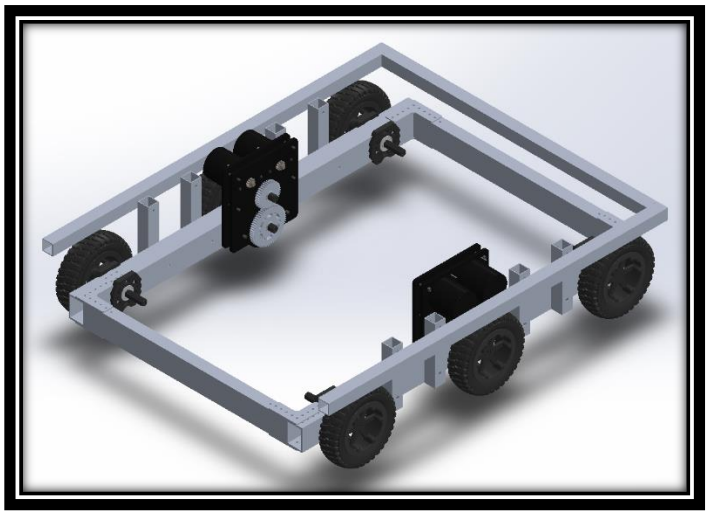
1. **Drivetrain**
    a. Fast and powerful
    b. Lightweight but strong
    c. Low center of gravity but adequate ground clearance for Rendezvous Point
2. **Shooter**
    a. Require consistently powered shot
    b. Ability to shoot from protected zones (prefer Trench)
    c. Easy feed from Hopper
3. **Power Cell Intake**
    a. "Touch-it, own-it" intake. Don't struggle to obtain Power Cells.
    b. Over the bumper – not through a frame gap
4. **Hopper**
    a. Must hold 5 Power Cells
    b. Ability to index Power Cells
    c. Bonus if hopper can accept balls from Human Player station
5. **Endgame Climb**
    a. Climb bar is 53" when level – will require us to reach up no matter robot height
    b. Require ratcheting winch system to prevent motor backdrive
6. **Control Panel**
    a. Simple mechanism for position and color control
    b. Expect this to be rarely used in early competition

DESIGN



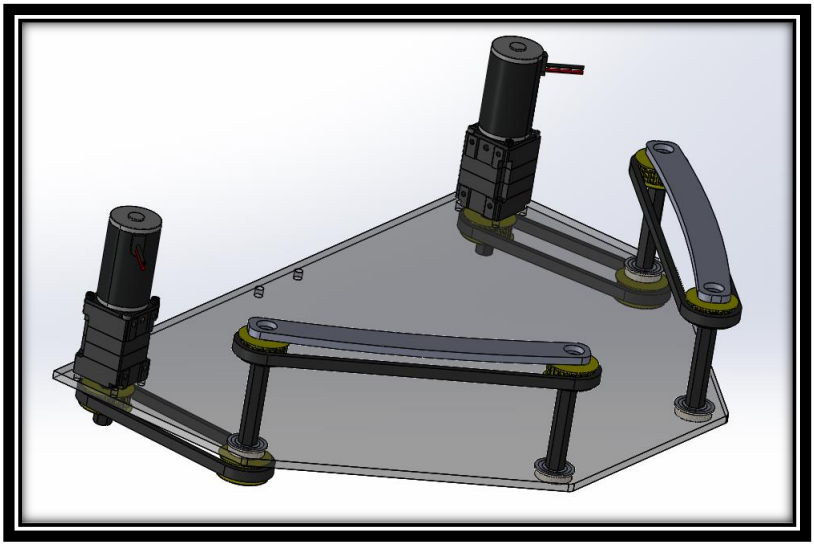
Chassis

The drive chassis is constructed in the West-Coast style that we have used in previous seasons. West Coast Drive places the wheels on the outside of the frame. This familiar style provided a design advantage when coupled with wider 2” x 1.5” aluminum tubing for the drive rails so that chain and sprocket could be run inside the tubing from the driven axle to remaining front and rear axles. While utilizing the chain-in-tube design that we also used 2016-2019 serves to save space, construction has to be precise since the chains are not easily maintained.



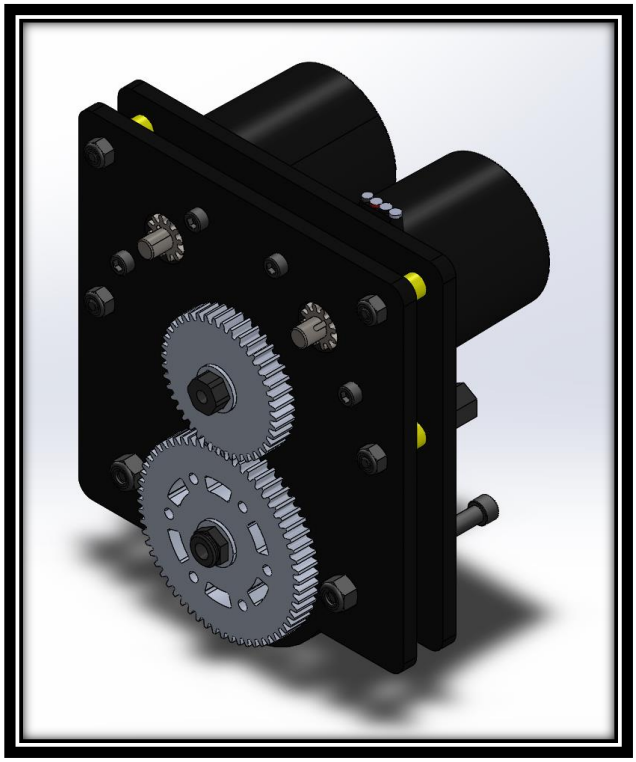
Hopper

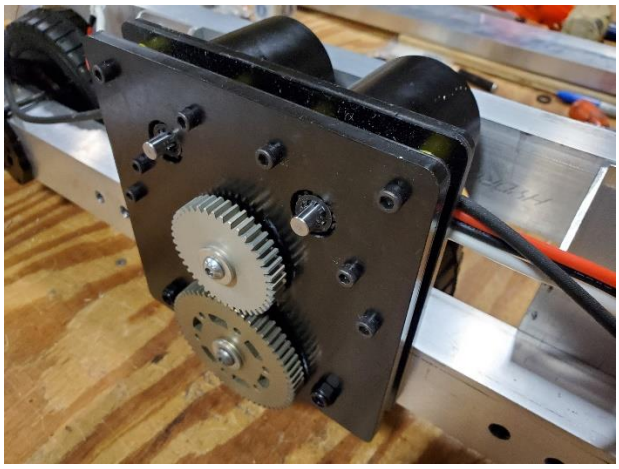
Inspired by the V Hopper design posted early this season by team 6135, we iterated on a few hopper designs to index balls into the shooter. Initially driven with belts and using polyurethane belting to move the balls, we simplified the design to have only the driving belts contact the balls. Additional testing showed the need for only one drive motor, but we’re prepared to add the other should the need arise. The hopper is hinged for access to components underneath.

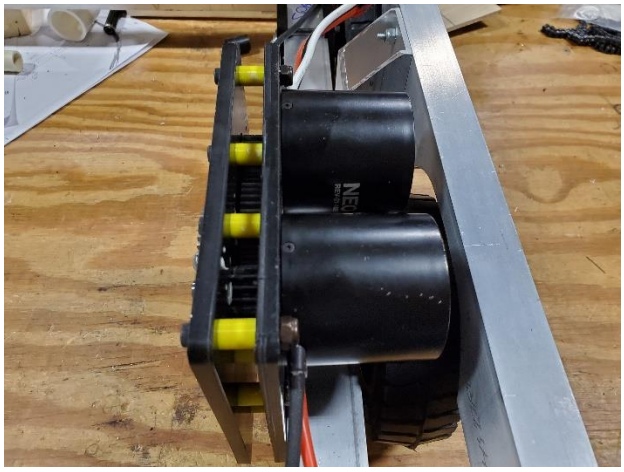


Custom “Flipped” Gearboxes

Inspired by a gearbox design from Team 2363 – Triple Helix, we designed and built completely custom flipped gearboxes. Flipping the motors up and over the drive wheel saves crucial interior space. We first used this style of flipped gearbox in the 2018 season to great success. Our previous usage of three CIM or Mini-CIM motors were replaced with two NEOs to save weight and space.







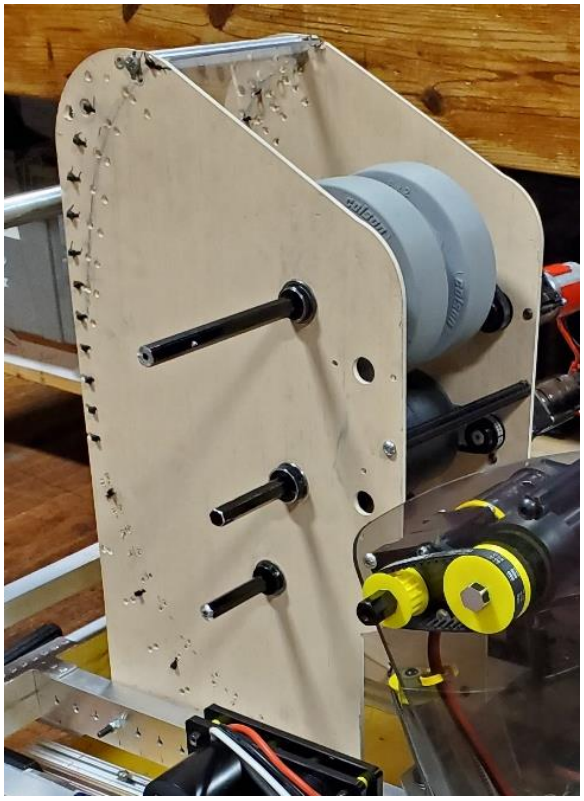
Power Cell Shooter

Initial prototyping of both “pitching machine” style and hooded shooters quickly showed pros and cons of both designs, with the pros of the hooded shooter winning out over the outright power of the pitching machine.

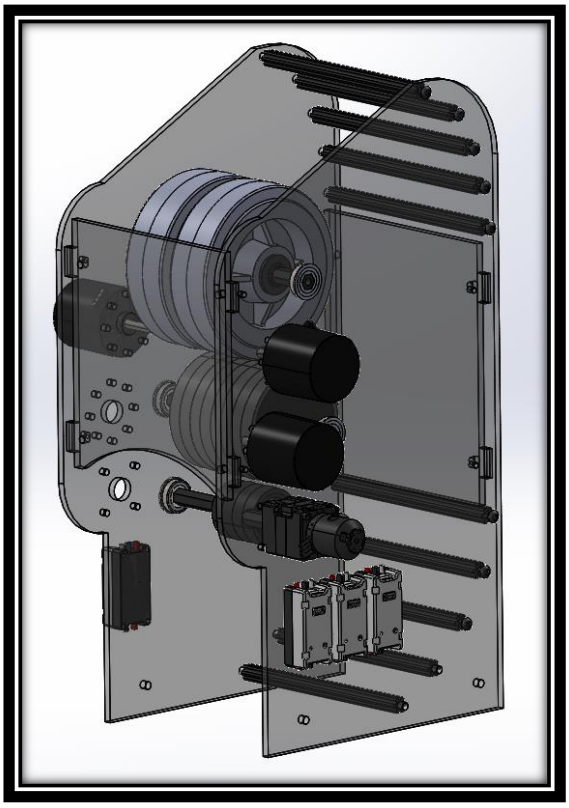
Shooter is powered by:

- 2 x NEO 1:1 belt driving 2 x 6”x2” Colson Performa wheels
- 1 x NEO 1:1 belt driving 4 x 4” AndyMark 60A Compliant Wheels
- 1 x NEO 550 36:1 belt driving 2 x 2” AndyMark 60A Intake Wheels

Shooter structure is ¼” polycarbonate cut by tabletop CNC router in our shop, supported by churro spacers.



Wooden shooter prototype

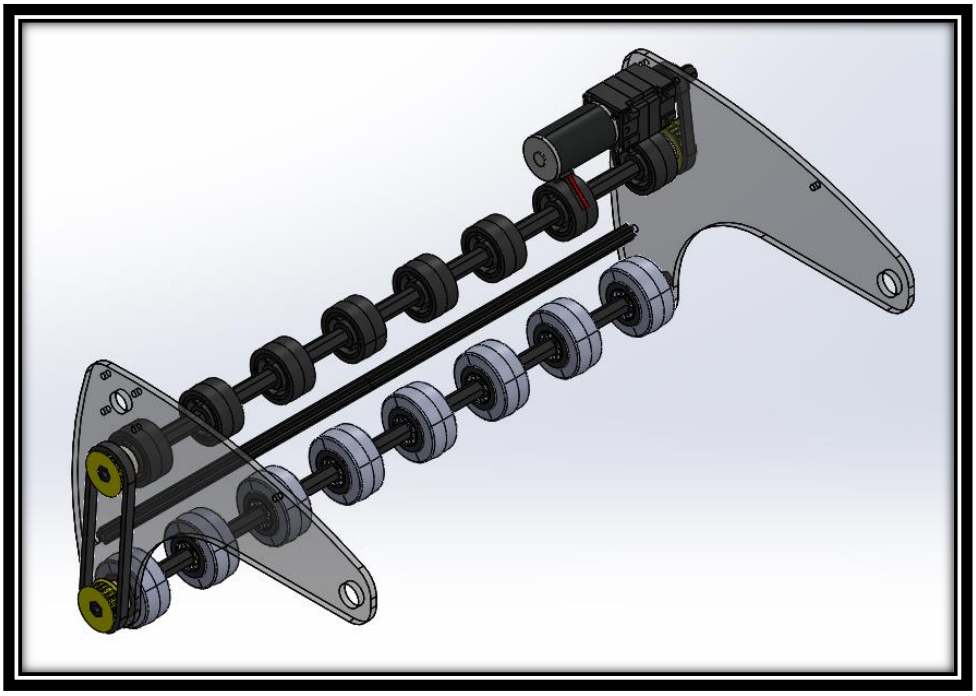


Power Cell Intake

Working from ideas based on a mix of our 2014, 2016, and 2018 intake designs, we prototyped a few different cargo intakes. Final design was inspired by a design posted early this season by Spectrum 3847. Custom 3D printed pulleys help to reduce weight and cost of the intake.

Intake prototype

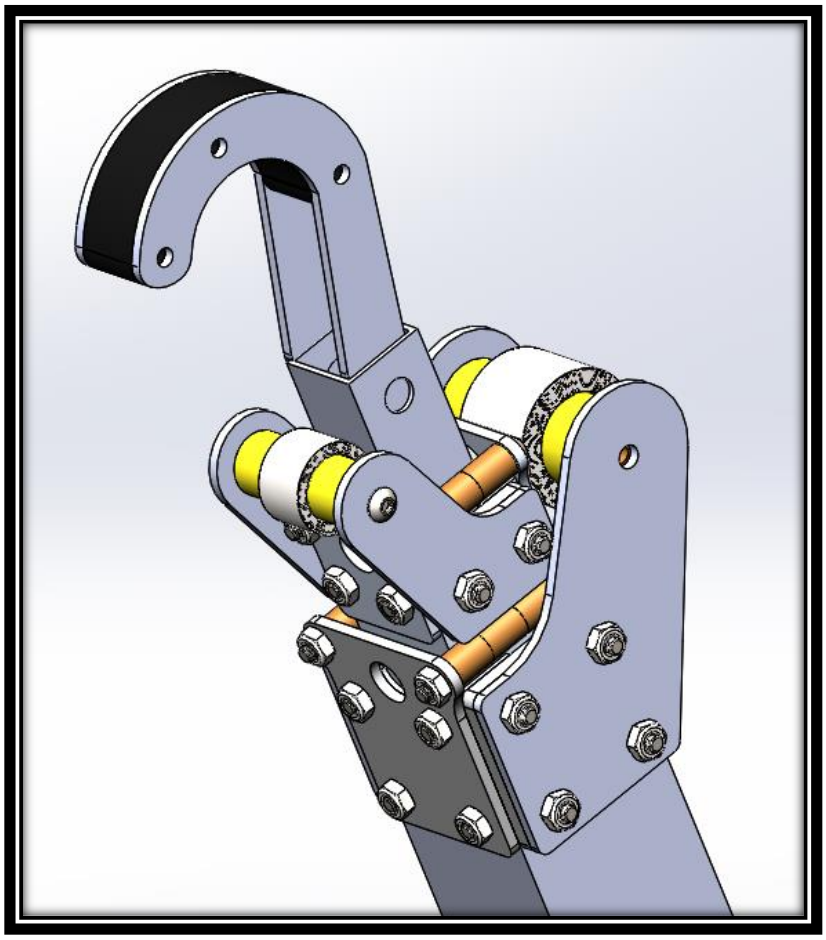
3D printed pulleys



Climb Arm & Winch

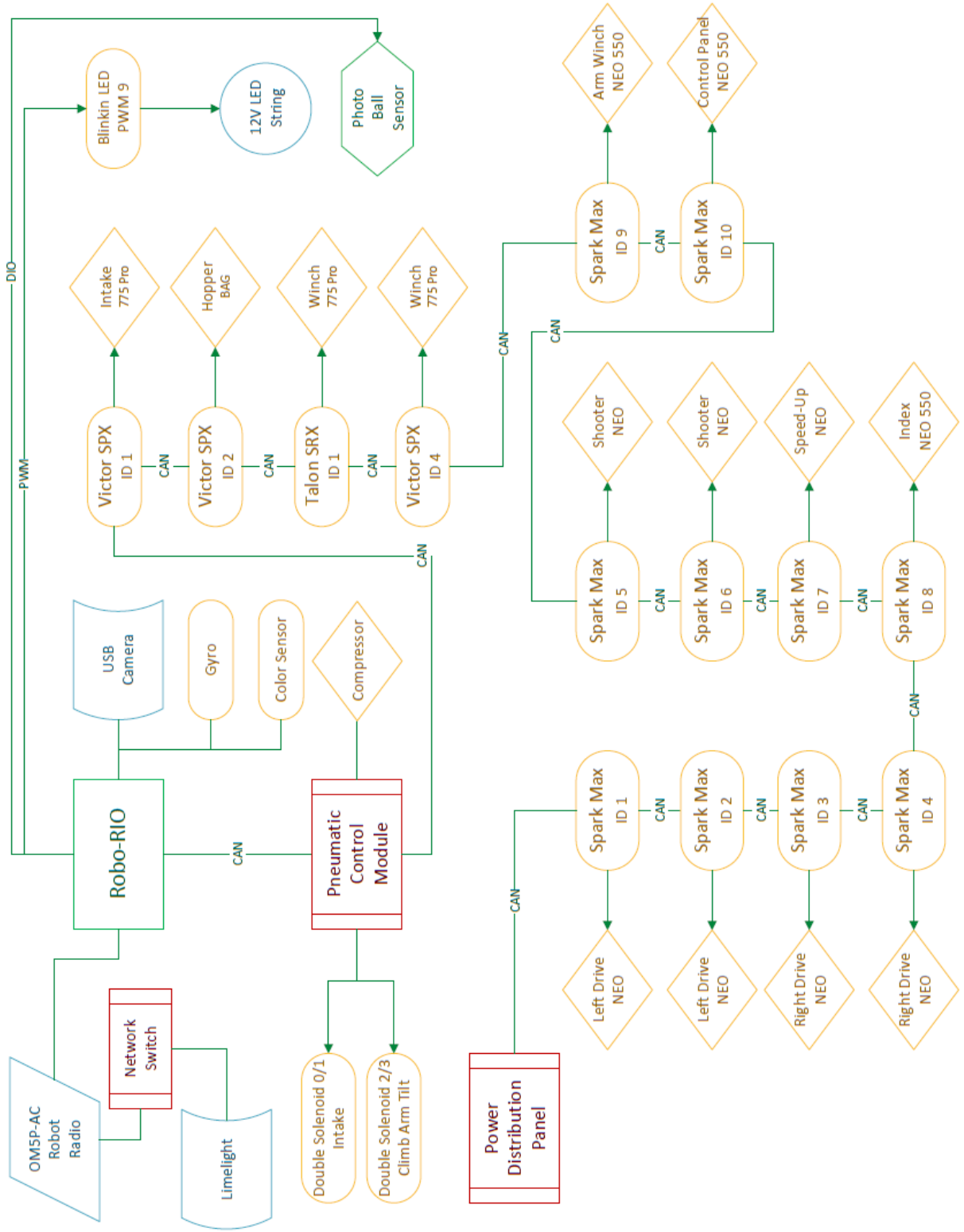
The climb arm is based on a design used by team 2659 in previous seasons. It utilizes three lengths of nested square aluminum tubing assisted by PTFE slides. Constant force springs cause the arm to want to extend at all times. We hold the arm in place with a small motor and winch setup. On the end of the arm is a custom hook, secured into the end of the smallest tubing with two sets of hook and loop tape.

The winch uses 2 x 775 Pros geared at 45:1 and a standard ½" ratchet wrench to prevent motor backdrive. 1000lb. Spectra cabling connected the arm hook to the winch, routed through an eye bolt to ensure the rope stays centered on the winch spool as the robot lifts.



PROGRAMMING AND CONTROLS

Communications Schematic



BLACKWATER ROBOTICS

Team History

Based out of Franklin High School, our team was founded in 2005 as the Builders of Tomorrow (BOT) by *FIRST* LEGO League coach Liz Burgess after seeing a nearby school compete at the 2004 NASA/VCU *FIRST* Robotics Competition Regional. BOT stormed onto the scene in 2005 as the Highest Rookie Seed, Rookie All-Star, and made an appearance at the World Championship in Atlanta. After this strong start, the team never looked back.

With a history of low funding, a rural city school system that has few interested students and no technical programs, and a consistent lack of engineering mentors, we have continued to succeed in competition with much larger teams. Our team is made up of students from 8th-12th grades in Franklin City Public Schools.

Re-branded in 2017 as Blackwater Robotics, we take pride in our local history and hope to soon expand our program to nearby schools.

Accomplishments

2019	*FIRST* Chesapeake Hampton Roads Event	Event Winner
2019	*FIRST* Chesapeake Central VA Event	Judges' Award
2019	*FIRST* Chesapeake Central VA Event	Event Finalist
2018	*FIRST* Chesapeake Hampton Roads Event	Excellence in Engineering
2018	*FIRST* Chesapeake Central VA Event	Event Winner
2018	*FIRST* Chesapeake Central VA Event	Quality Award
2017	*FIRST* Chesapeake Hampton Roads Event	Event Winner
2017	*FIRST* Chesapeake Hampton Roads Event	Quality Award
2015	Chesapeake Regional	Event Finalist
2015	Virginia Regional	Event Winner
2014	Chesapeake Regional	Event Finalist
2014	Chesapeake Regional	Quality Award
2014	Virginia Regional	Event Winner
2013	Virginia Regional	Event Winner
2007	NASA/VCU Regional	Event Finalist
2006	NASA/VCU Regional	Event Winner
2005	NASA/VCU Regional	Rookie All-Star
2005	NASA/VCU Regional	Highest Rookie Seed

Blackwater Tugboat History

By Clyde Parker

On Nov. 1, 1937, when Chesapeake-Camp Corp. started producing paper, in Franklin, a newly formed "River Operations" department was organized to help supply the mill with pulpwood, which was to be accumulated at Winton, North Carolina from that area's pine woodlands, by pulling barges loaded with pulpwood up the Chowan and Blackwater rivers to Franklin. Barges were acquired. A tugboat was needed.

In response to that need, in early 1938, a steam-powered tugboat named "Corinthia," built in 1890 in Philadelphia, was purchased and put into action with Harry B. Ward Sr. as its captain. "It was a ragged-looking thing," Harry Ward Jr. recalled for an article in the Spring 1999 edition of Union-Camp's magazine, "The Log." The tugboat had been in disuse for several years prior to being purchased and refurbished by Chesapeake-Camp.

In 1970 a tugboat by the name of "Convoy," originally built for the United States Army Corps of Engineers, joined the Union Camp tugboat fleet. Soon after its purchase, it was re-named the "Cotton J" in honor of J.B. "Cotton" Johnson who was, at that time, manager of Union Camp's Woodlands Division, operating out of Franklin.

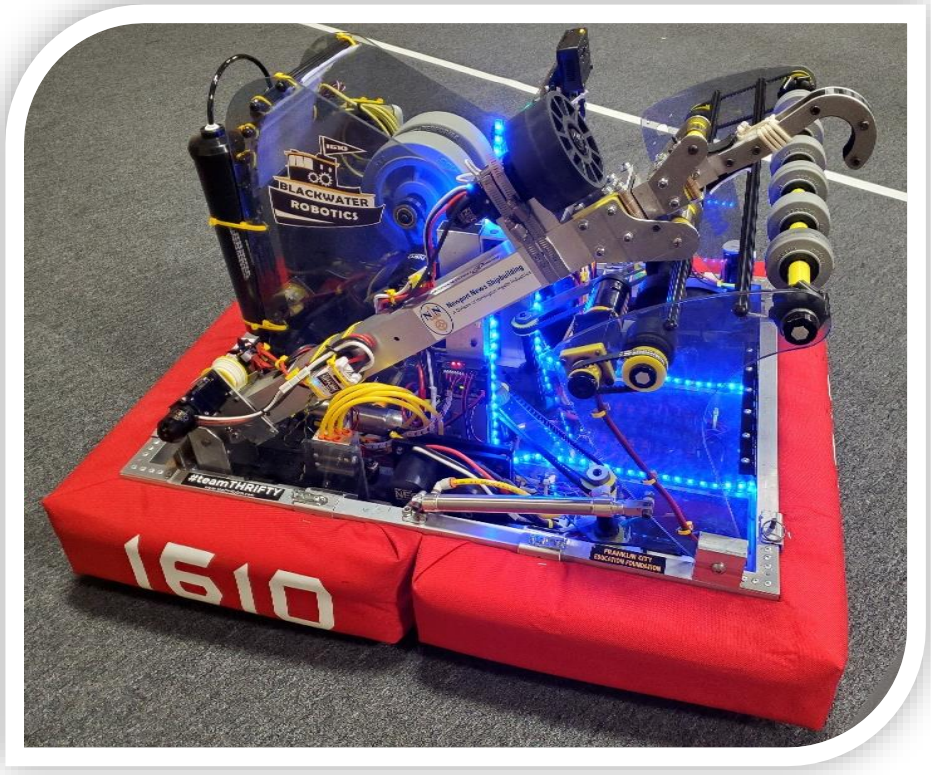
Southampton County Sheriff Jack Stutts, grandson of "Cotton" Johnson, son of the late Joe Stutts of Union Camp, and son of the late Carolyn Johnson Stutts, remembers the "Cotton J" well. "I used to take rides up and down the Blackwater and Chowan rivers on the 'Cotton J' with my grandfather," he said recently. "And I rode on some of the other tugs; they were all exciting experiences, but, of course, I liked 'Cotton J' the best."

Though smaller than its predecessor, the "Cotton J" kept river operations going until 1972 when a newer tugboat, the "Tuscarora," was put into service. It was named after an Indian tribe that lived along the Chowan River.

Dorothy

The Dorothy was the first vessel ever built by then Newport News Shipbuilding in 1891 and has the distinction of being "Hull No. 1." Dorothy was considered very innovative for its time being the first tugboat ever built with a quadruple expansion engine. Dorothy was designed by noted Naval architect and engineer Horace See. It was named after the then four year old daughter of former Navy Secretary William C. Whitney.

Dorothy first served for 20 years in New York harbor but then moved back to home waters in 1912 to Norfolk towing barges up and down the Chesapeake Bay and east coast. Dorothy was even used by the U.S. Navy during WWI. In 1964 she was damaged in a collision with a barge and was saved ten years later and brought back to Newport News. After a two year restoration process, she was rechristened in 1976 and has been on display in front of Newport News Shipbuilding's offices ever since. At well over 100 years old she is a testament to the quality and longevity of Newport News built ships.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