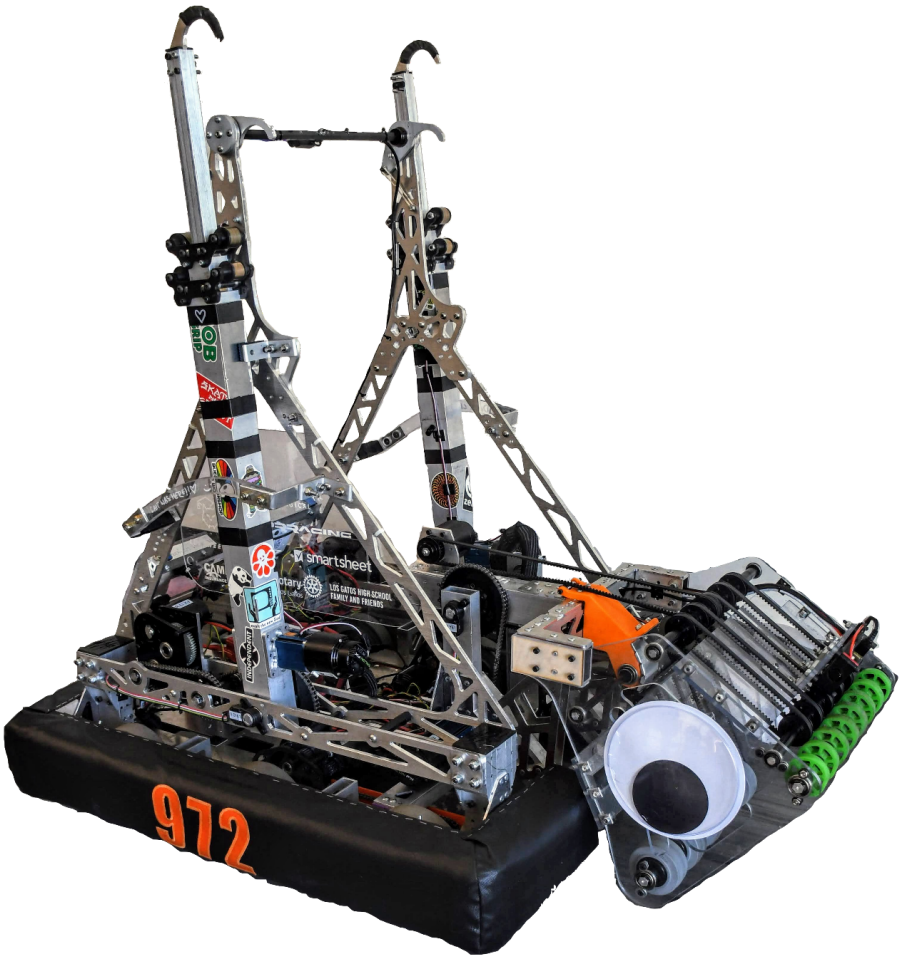
FRC Team 972
"Marinus"



Weight: 114 lbs
Starting Height: 41.25”

Frame Perimeter: 114”
Max Height: 65”

Design Goals

After studying the game manual, we came up with things we wanted to do and designed our robot based on these requirements.

Aspect	Functional Requirements	Design
Drivetrain	• At least 10 ft/s	• 4 Falcon 500 motors • 6 x 6-inch Colson wheels • Drop center
Auto	• Move beyond tarmac • Score at least 2 cargo into high hub	• Encoder-based auto path • Variety of Pathweaver paths with Ramsete controller
Cargo	• Touch it, own it • Consistently deposit into high or low hub • Outtake over various distances • Max time cargo in robot (assuming ideal positioning) is 3 sec	• Compliant and Colson rollers for intaking & shooting • Separate indexing belts • Powered by 2 Falcons • Intakes from one side • Outtakes from both sides • Vision for Ball-Chasing and distance estimations
Climb	• Climbs mid rung in under 5 seconds, high rung around 15 seconds, and traverse rung around 30 seconds • Mostly autonomous up to the high rung	• Two rotating Thrifty Bot telescopes • Two static, spring hooks • PID control for telescopes and rotators • Switches off between extender to static arms • Magnetic limit switch at zero position
Programming	• Driver can drive with limited view • Sensors to know if cargo is in robot • Sensors to aid alignment	• Limelight • Wide-angle driver camera • Color sensor • Encoders

Strategy

Robot scores in the Low or Upper Hub during auto and teleop, and climbs to any rung during End Game.

Autonomous (15 sec)

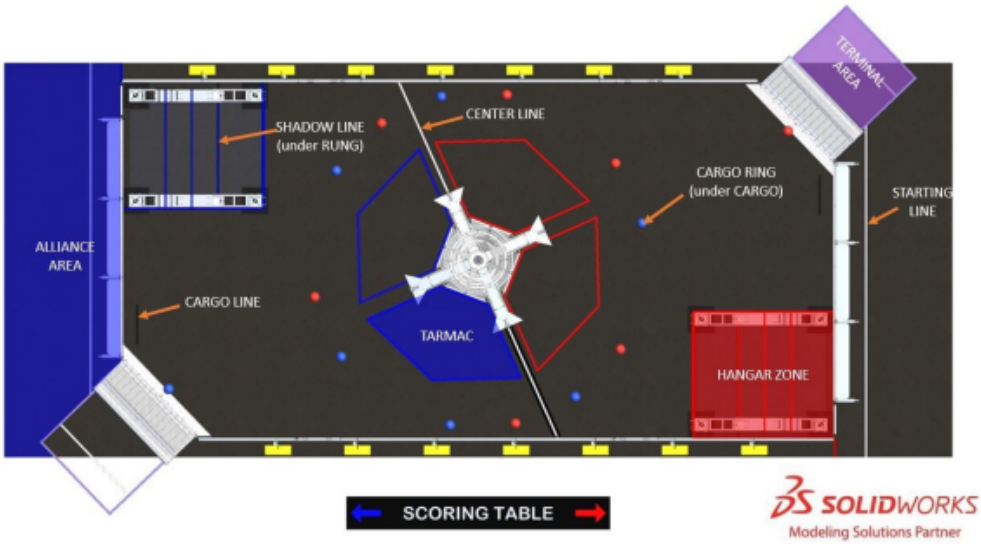
- Drive off tarmac
- Score 2 cargo into upper hub (shoot from back, drive forward to intake, shoot from back again)

Tele-Operated (1 min 45 sec)

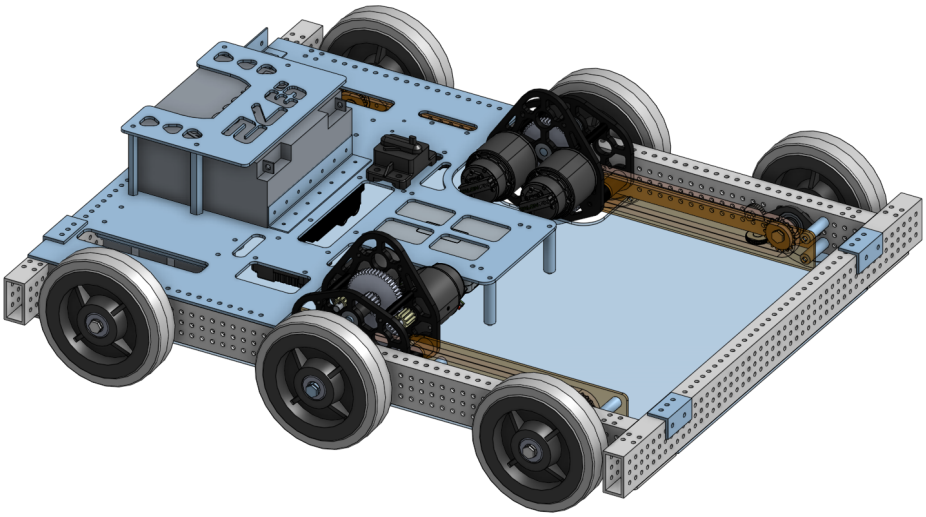
- Consistently score into upper hub from anywhere in tarmac
- Cycle: travel to ball, intake, rotate to hub, outtake into low or upper hub
- Estimate 8 second cycle
    - Based on location of the balls, based on hub's exits
    - Score up to 10 cargo in teleop, assuming endgame climb
- Play defense as needed (pin robots, shoot opponent balls away etc.)

Endgame (30 sec)

- Continue scoring cargo as needed
- Consistently climb to low, mid, high, or traverse rung depending on alliance strategy



Drivetrain



The robot uses a standard West Coast Drivetrain with 6 x 6” Colson wheels and a compact rectangular chassis.

West Coast Drive

- 6 x 6” Colson wheels to combat defense
- 0.0625” center drop for easier turning
- WCP Snail Gears to maintain tension in the the chains

Chassis

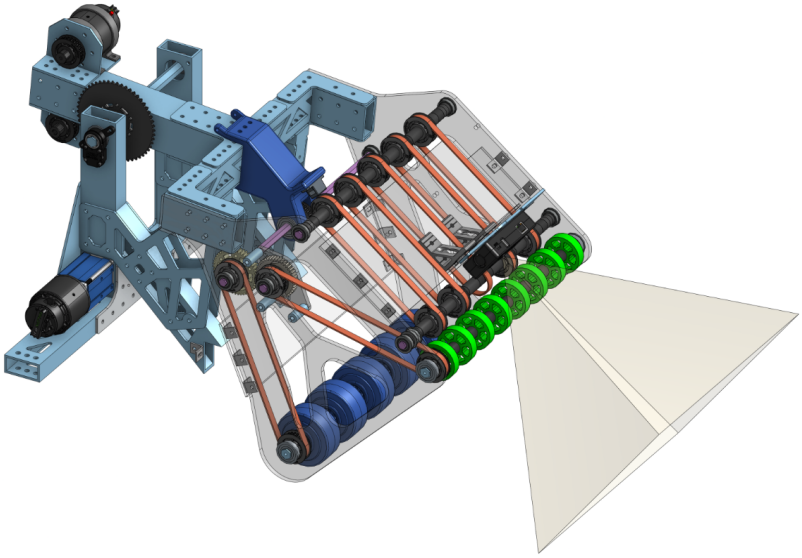
- 27” x 30” chassis
- 0.5” hole pattern for easy superstructure mounting
- Spacious electronics layout
- 0.125” wall 2x1 tubing to keep CG low and increase strength
- Compact for maneuverability
- Allows space for other robots climbing on the hanger
- Acrylic guards to protect electrical board against chain

Gearbox

- Max Speed of 12.03 ft/sec
- 4 Falcon 500s allow for an extremely powerful and efficient drivetrain

Intake/Shooter Claw

(a.k.a the “Mushroom”)



This combined intake/shooter claw flips forward to intake cargo from the ground and rotates to any angle for shooting into the low or high hub. Two bars of rollers intake and shoot the balls while indexing belts keep the cargo in place while the shooter spins up.

Pivot

- Stowed, intake, and various shooting positions
- Hard stops with nitrile tread on each side
- Powered by a Falcon 500 with a 144:1 gear ratio
- Rotates 175° for forward and backward shooting
- REV through-bore absolute encoder to assist in PIDF

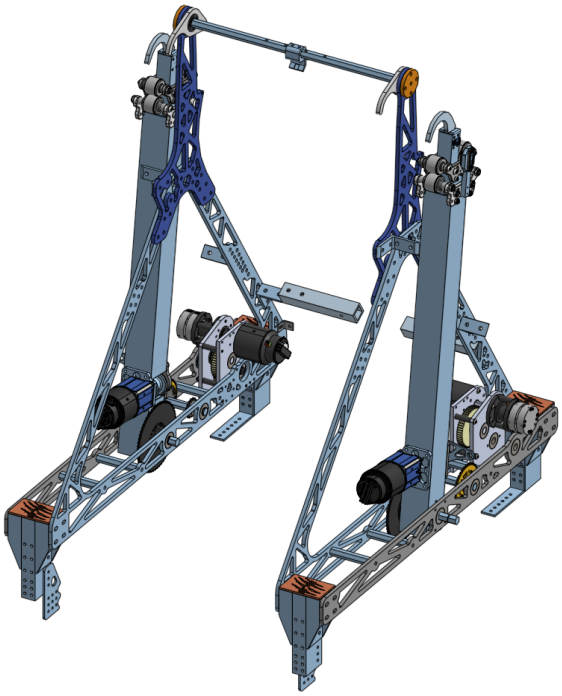
Rollers

- One roller with eight 35A durometer 2” compliant wheels
- One roller with five 3” Colson wheels
- Powered by a Falcon 500

Belt Indexers

- Five belts keep cargo in claw and pushes them into shooting wheels
- Powered by a Falcon 500 with a 1:1 gear ratio
- Color sensor determines presence cargo, automatically retracts arm

Climb



Rotating telescoping arms from ThriftyBot with a hook mounted on top designed to reach up to the mid rung from the ground and to high rung while spring-loaded hooks mounted to superstructure are latched. It then repeats to reach the traverse rung.

Rotation

- Powered by a Falcon 500 on each side with a 170:1 gear ratio
- REV through-bore encoder to measure absolute position for PID control

Telescoping Arms

- Three-stage telescoping arms from ThriftyBot with modification
- Extends with constant-force springs, retracts with UHMWPE cord around spool
- Powered by a Falcon 500 on each side with a 20:1 gear ratio

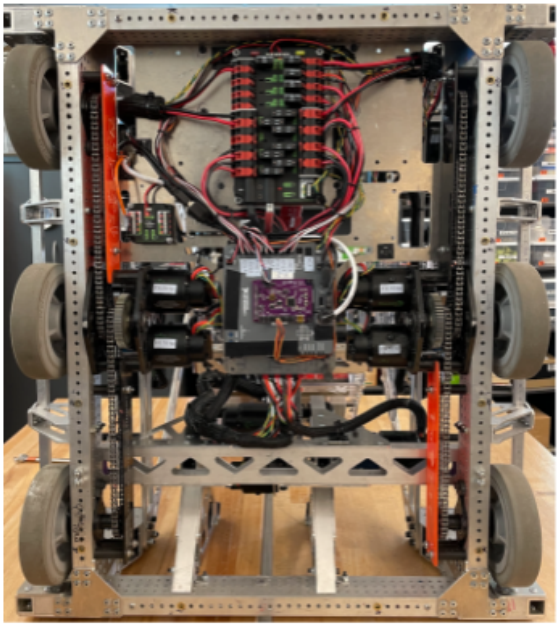
Superstructure

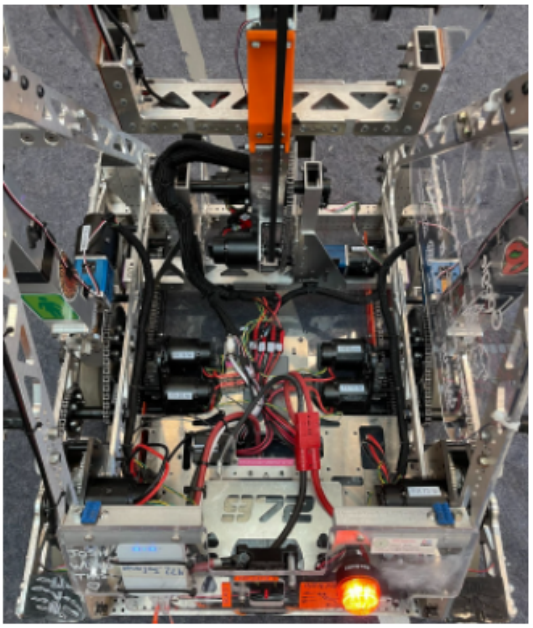
- Pocketed holes for weight reduction and cable tie mounting points
- Cross bar to maintain stability and mount driver camera

Static Hooks

- Pass through the bar while ascending and latch on
- Hard stops cutouts for hooks to lay flush
- Modular design allows for hooks to be swiftly removed and replaced

Electrical





The electrical board is flipped for ease of inspection, serviceability, and clearance. Most electrical components are placed on the underside so that they may be easily accessed as the robot is on its side. An additional polycarbonate sheet is attached on the superstructure for commonly accessed and visible components.

Flipped Electrical Board

- Electronics on the underside and reduced size allow for more mounting space and clearance
- RoboRIO, PDP, and VRM accessible with the robot on its side
- Large 0.125” polycarbonate sheet protects electronics from debris

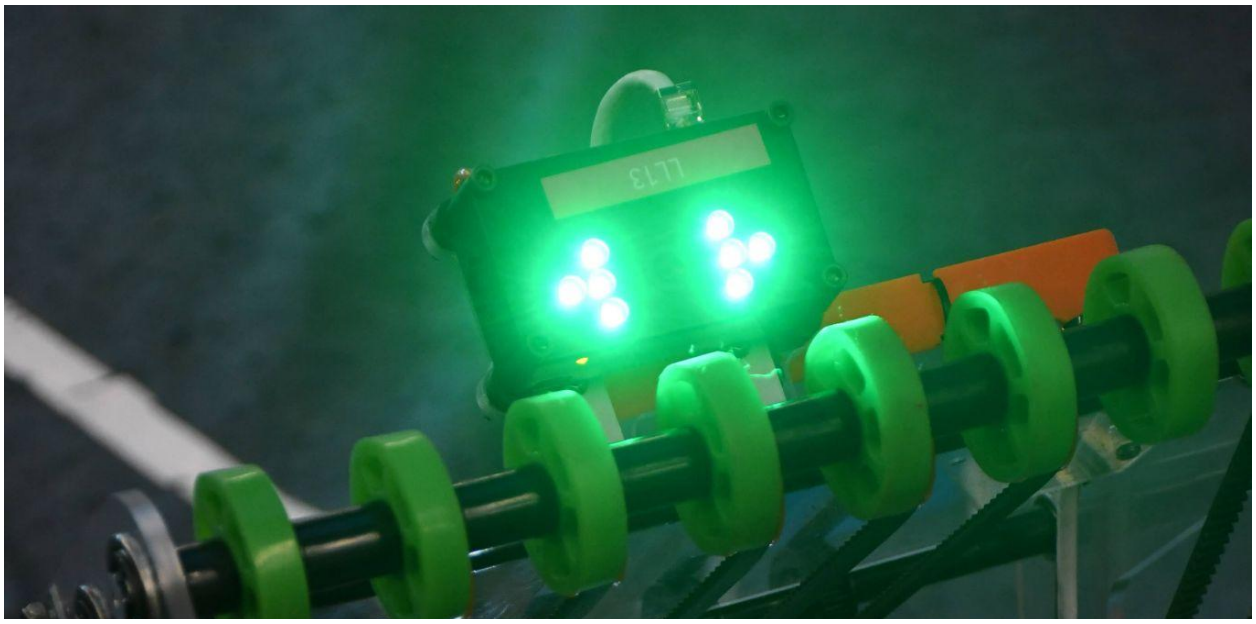
Battery Holder

- Battery can be easily slip in from the back
- Straps with buckles along with a removable bracket hold the battery in place

Polycarbonate Board

- Bridge and RSL are visible
- Robot USB port and breaker are accessible, but protected from projectiles

Computer Vision



A Limelight 2+ mounted on top of the intake/shooter claw allows for a dynamic range of views (59.6º x 49.7º) to assist in semi-autonomous intaking. It also calculates the distance to the retro-reflective tape on the high hub, which is used to determine the optimal shooter wheel velocity and arm angle for high hub shooting. Additionally, it is useful for alignment when climbing.

Ball-Tracking

- Large view of ground with claw flipped out
- Artificially increases acquisition zone
- Automatically turns towards and approaches cargo of appropriate color

Shooting

- Shoots from anywhere around tarmac edge
- Automatically calculates optimal shooting speed and angle