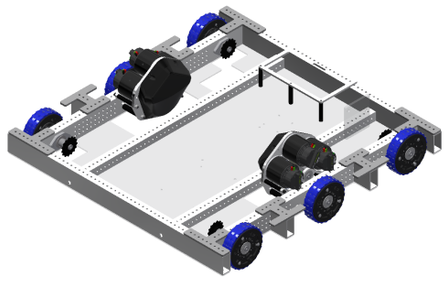
2021-22 TECHNICAL SUMMARY

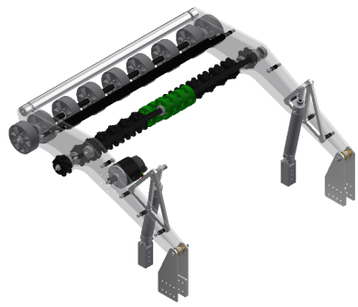
We are team 1241 THEORY6 from Rick Hansen Secondary School in Mississauga, Ontario. Since 2003, our team has been building our city and province's robotics program to become a model for STEM equity and excellence. Through pandemics, school closures, and team rebuilding, over the last 19 years THEORY6 has succeeded in inspiring future engineers and promoting STEM education to all of our communities. Our team's motivation is rooted in each individual's passion for STEM and our team's goal to strategically build robust robots. We have used a plethora of industry-practiced engineering principles in order to produce THEORY6's 2022 robot: Fender Bender.

Drivetrain



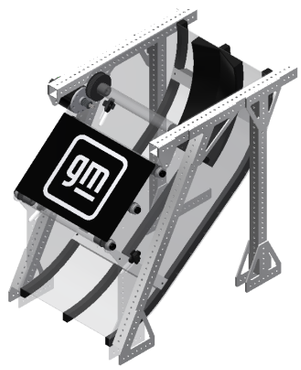
- 6 Wheel drive with 4" blue nitrile traction wheels and a .09" Center Drop
- 27.5" x 27" chassis size
- Single speed gearbox with 3 falcons on each side
    - Speed of the drivetrain is 15.21 ft/s, 12.93 ft/s adjusted
    - Gear reduction of 7.32:1
- #35 chain with 15 teeth sprockets
- 1/16th Polycarbonate Bellypan for electrical mounting, with access holes for drive and hanger gearboxes

Intake



- Three roller intake for floor pick-up
    - Front roller with 3 in. compliant wheels to grab balls from the wall and corners easily
    - Mecanum roller centers balls against the bumper as the ball enters the robot with 1" pinch
    - Compliant roller transitions balls from the intake to the conveyor
- Driven by one Falcon 500 motor
    - Linear speed of rollers is 18.5 ft/s
    - Gear reduction of 1:3 ratio done using 16 tooth pinion to a 48 tooth pulley
- Pivoted using two double-acting 1-1/16" Bore, 4" Stroke pneumatic cylinders

Conveyor



- 1 Falcon 500 motor powering the Conveyor
- 3D printed pulleys/hubs pressed into rollers
- 16:60 pulley reduction from the motor to rollers
    - 7.4ft/s linear speed
- Four 1" polycarbonate rollers ran in parallel on one side of the subsystem with a ⅝" ball pinch
- 3 beam break IR sensors to index balls
- Fully automated to ensure consistent feeding for shooter and reduce operator load

Shooter

- 2 Falcon 500 motors powering a double Flywheel Shooter with a 24:48 pulley reduction
    - The Double Flywheel shooter limits the amount of spin preventing the ball to bounce out the high hub goal
- Pneumatically actuated 2 position hood for variability in shot position on the field
- 4" diameter x 6" wide main shooter wheel
- Two 2" diameter x 5" wide hood rollers to launch the ball in a more linear path

- Four 3D printed aligning rollers to keep the ball centered as it exits the shooter
- Limelight vision tracking system to track and auto align shots with the Hub
- IR beam break sensor programmed to feed the ball only when the flywheel is at the desired RPM

Hanger

- Single-stage telescopic arm with a pivoting hook, raises robot 18in off the ground
- One hook accommodates Low and Mid Rung heights
- Gearbox consists of 1 Falcon 500
    - Gear reduction of 13.95 : 1
    - Sub 1 second climb
- Mechanical brake to maintain hanging position

Controls

- Use of the Falcon 500 motor for every mechanism due to its efficiency, high torque specs, integrated motor controllers and encoders. There is a combined use of Finite State Machines with Commands to control the robot.

Drivetrain

- NavX gyro to determine the heading of the robot relative to its starting position.
- Track robots (x,y) position using onboard encoders on the field to align to goal even when evading Limelight view
- Using vision tracking and limelight data to auto-align to the target in the x-axis
    - Use of PID closed loop control to compensate for any accumulated error over time
    - Ramp-in for drive distance PID to eliminate encoder error due to wheel slippage

Intake

- Rollers are automatically driven as the pneumatic cylinders extend the intake

Conveyor

- Automation Logic for cargo storing
    - Use the 3 IR beam breaks and color sensors to determine the location of the balls in the conveyor and index them accordingly
    - Use of voltage compensation to apply a consistent amount of power to the rollers regardless of battery life

Shooter

- Integrated Falcon 500 motor controller and encoder to determine and maintain flywheel speed
    - PIF closed loop control for velocity
- Pneumatic cylinders to switch between two hood angles
- LimeLight vision tracking to position the robot to the goal before setting up shooter parameters
- Multiple shot RPMs interpolated from various positions located on the field (tarmac line, past launch pad)

Hanger

- Two hall-effect sensors to determine the extended and retracted limits of the telescoping mechanism.
- Brake auto-engage/disengage when hanger extends or retracts

Autonomous

- 5 ball autonomous sequence within 14.5 seconds