TECHNICAL BINDER

CHARGERS

5409

FRC 2023

FRC
FIRST® Robotics Competition

CHARGED UP
PRESENTED BY HAAS

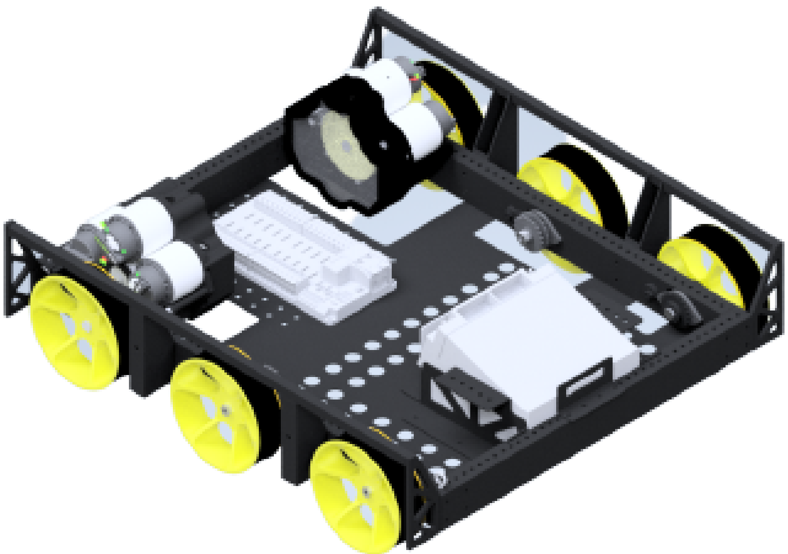
BISHOP 5409

Garth Webb Secondary School, located in Oakville, Ontario is named after D-Day veteran Garth Webb, who founded the Juno Beach Centre in Normandy. Webb fought in World War II as a member of the 14th Field Regiment of the Royal Canadian Artillery. He was awarded the Meritorious Service Cross and the Legion of Honour medal.

Since 2018, 5409 Chargers Robotics has honored Canadian veterans through the naming of their competition robots. Previous robot names have included Juno (2018), Vimy (2019), Ortona (2020), and Dunkirk (2022). This year's robot is named after WWI flying ace Billy Bishop.

William Avery (Billy) Bishop Jr., VC, CB, DSO & Bar, MC, DFC, ED, First World War flying ace, author (born 1894 in Owen Sound, ON; died 1956 in Palm Beach, Florida). Billy Bishop is widely known as the top Canadian flying ace of the First World War, boasting 72 victories and numerous accolades. He was an Air Marshal and the recipient of many medals. During the Second World War, he was a key player in the implementation of the British Commonwealth Air Training Plan.

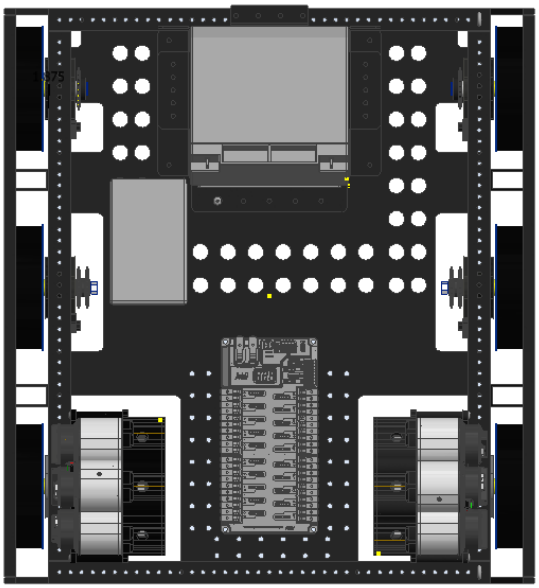
DRIVE TRAIN



Our drivetrain this year was designed to be compact, so we can easily fit on the charge station, as well as appeal to other teams who might have bigger robots. This chassis is key to forming an alliance with other teams looking for a small robot.

Chassis

- *6-Wheel West Coast Drive*
- *6" wheels*
- *2 x 1 x 0.100" aluminum tube*
- *24" x 26"*



Electrical Components:

- *Single-speed gearbox (x2) (see GEARBOX page)*
- *Custom made gearbox and machined in-house.*
- *Power Distribution Hub (PDH)*
- *Custom battery mount*

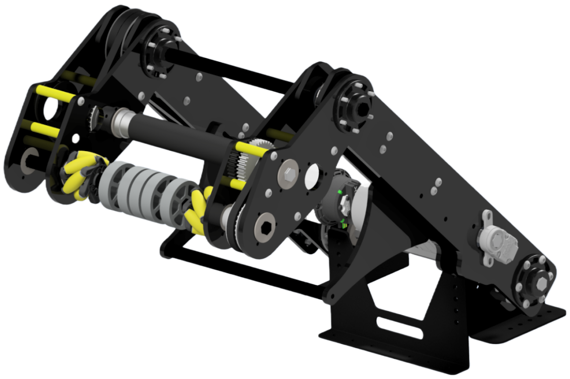
GEAR BOX

Bishop features a single-speed gearbox instead of a 2-speed one,as the high gear of last year's gear box allowed the robot to be pushed around. At the start of the season, a gearbox was used on a test chassis to figure out what speed to use. In the end, Bishop needed to be a quick robot. After testing, several adjustments were made to the gearbox to achieve the desired outcome. The finished gearbox is easily adjustable and well protected, and fits the team's parametric West Coast Drive.

'Red Bull' Info

- *The gearbox is called 'Red Bull' because it gives the drivetrain wings.*
- *Red Bull uses 3 falcon 500 motors, which help the robot reach 6.3 horsepower while motors are at peak power.*
- *Red Bull's powerful design helps Bishop output 164 ft-lb of torque. That's more than a Hyundai Elantra! All this torque ensures that the robot isn't going to be pushed around by other robots.*
- *The lightweight gearbox plates weigh just 1 pound. This is because of the complex lightening hole patterns in the plates, which reduce the weight a significant amount.*
- *This custom gearbox has an overall 7.9:1 reduction, held in place using custom hex shafts. This eliminates the need for an excessive amount of E-clips or clamping collars.*
- *The 2 gear reductions means the robot can reach a drive train speed of 17 ft per second.*

INTAKE SYSTEM



This year, it was decided to go with a cone-oriented over-the-bumper intake. This intake consists of doubled-sheared polycarb plates with rollers, a wrist, and a pivot which run off 3 motors.

Cone Acquisition:

- *2 belt-driven rollers powered by a Falcon 500 motor*
- *Both rollers compress and pull in cones. The rear roller and the stanchion are for compressing cubes.*

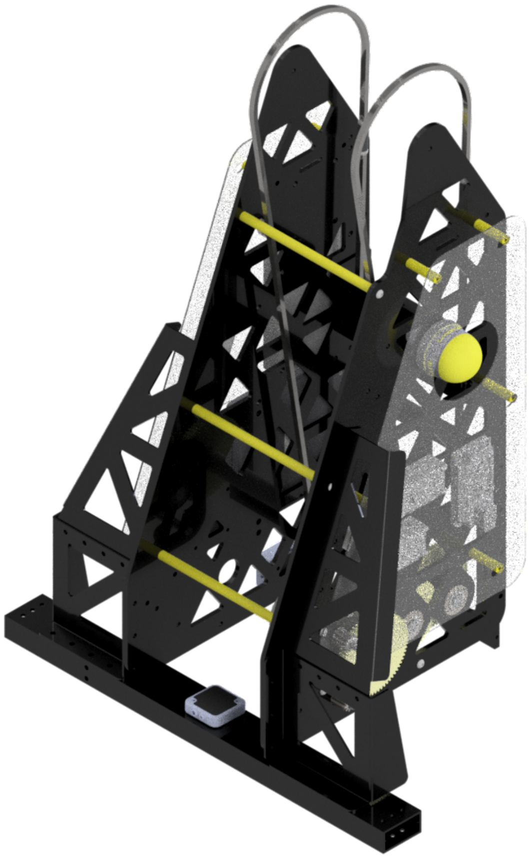
Plates and Wrist Mechanism:

- *¼" double-sheared polycarbonate plates provide enough durability and flex to withstand impacts and protect internal pulleys, gears, and belts*
- *Plates rest firmly on the bumper when in the lowered position and tuck in under the arm in the raised position*
- *Wrist is driven by a NEO motor with a MaxPlanetary Gearbox to rotate the cones and hand off to the claw.*

Lower Pivot:

- *Driven by a NEO motor with a MaxPlanetary Gearbox located on the belly pan of the robot*
- *Pivots in and out of the robot to pick up and hand off cones to the claw.*

SHOULDER JOINT



The shoulder acts as a pivot joint for the extension arm, as well as the location where most of the robot's electronics are mounted.

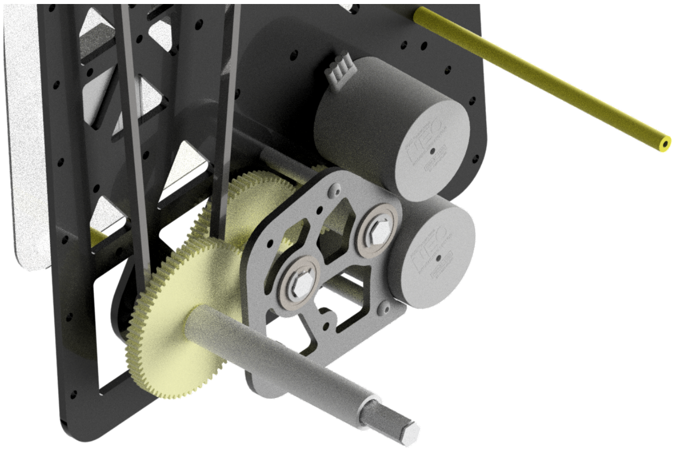
Electronics:

- roboRIO
- 2 Spark Motor Controllers
- CANivore
- Radio and Radio Power Module
- TP-Link Network Switch
- Main Switch
- VRM
- Pigeon
- Light
- Mini Power Module
- Limelight

The shoulder consists of the 2 side plates, mounted electronics, and the shoulder gearbox.

Gearbox:

- Powered by 2 NEO brushless motors, 138:1 reduction over 4 stages
- 0.197" thick aluminum, 24" tall
- Powers 72t sprockets which rotate the extension arm 90 degrees in 0.51 seconds



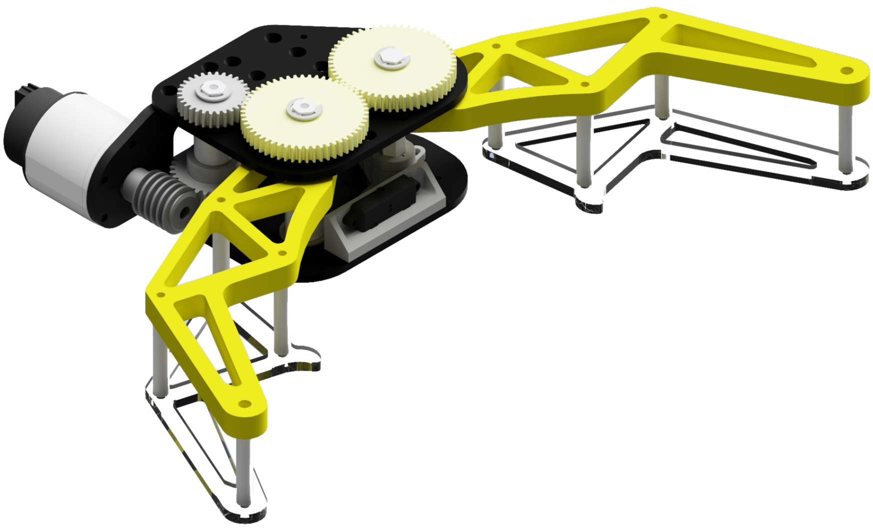
EXTENSION ARM

The Extension Arm is a fast and effective way of manipulating game pieces. It uses a telescoping mechanism to extend its reach to various distances.

<u>Details:</u>

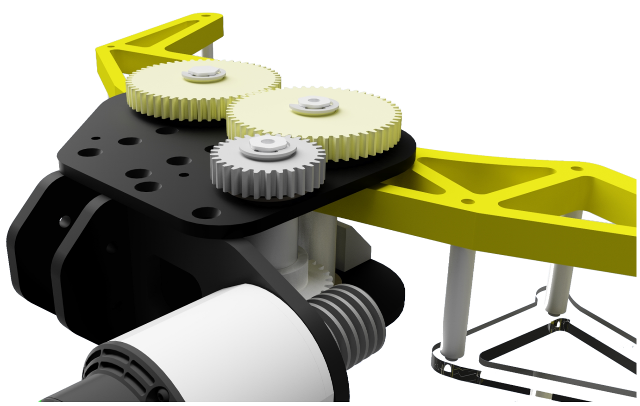
- *3- 2" x 1" Aluminum Tubes with 0.100" wall thickness*
- *Uses 1 Neo with 20:1 reduction on a two-stage gearbox producing a linear speed of 82 in/s fully loaded*
- *Has 1 SparkMax motor controller mounted on the stationary tube above the motor*
- *Uses 2 magnetic limit sensors on one of the stationary tubes and 1 magnet on the active tube to determine the home and fully extended positions*
- *A 38.5 in. long chain used to drive the active tube*
- *Custom bearing blocks mounted on all tubes to ensure smooth movement of the system*
- *The arm is of traveling from the closed to fully extended position in 0.53 seconds and can handle around 715 lbs of load*

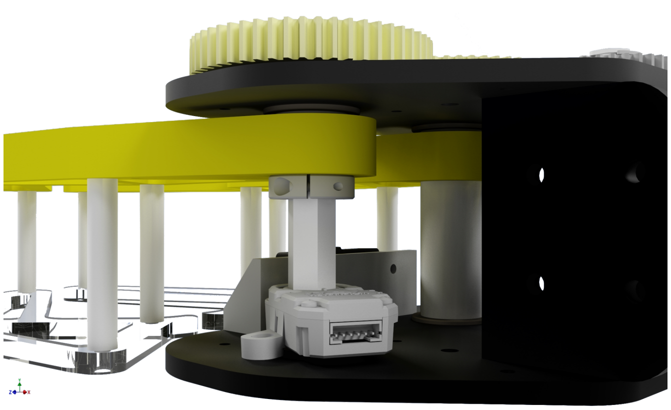
CLAW MK3



This is an improved version of Claw MK2, with major improvements in the transmission mechanism. The use of a worm drive limits the direction of transmission and prevents the motor from stalling. The update also includes alignment plates, which further secures the grip of game pieces.

Main Material: 6061 Aluminum
Motor: Falcon 500 Brushless
Transmission System:
30 : 1 Worm Drive + Spur GearsOverall Ratio: 54 : 1
Max Stall Load: 179 lbs (796 N)
Current @ Max Stall Load: 24.3 A
Total Weight : approx 5.7 lbs (2.6 kg)





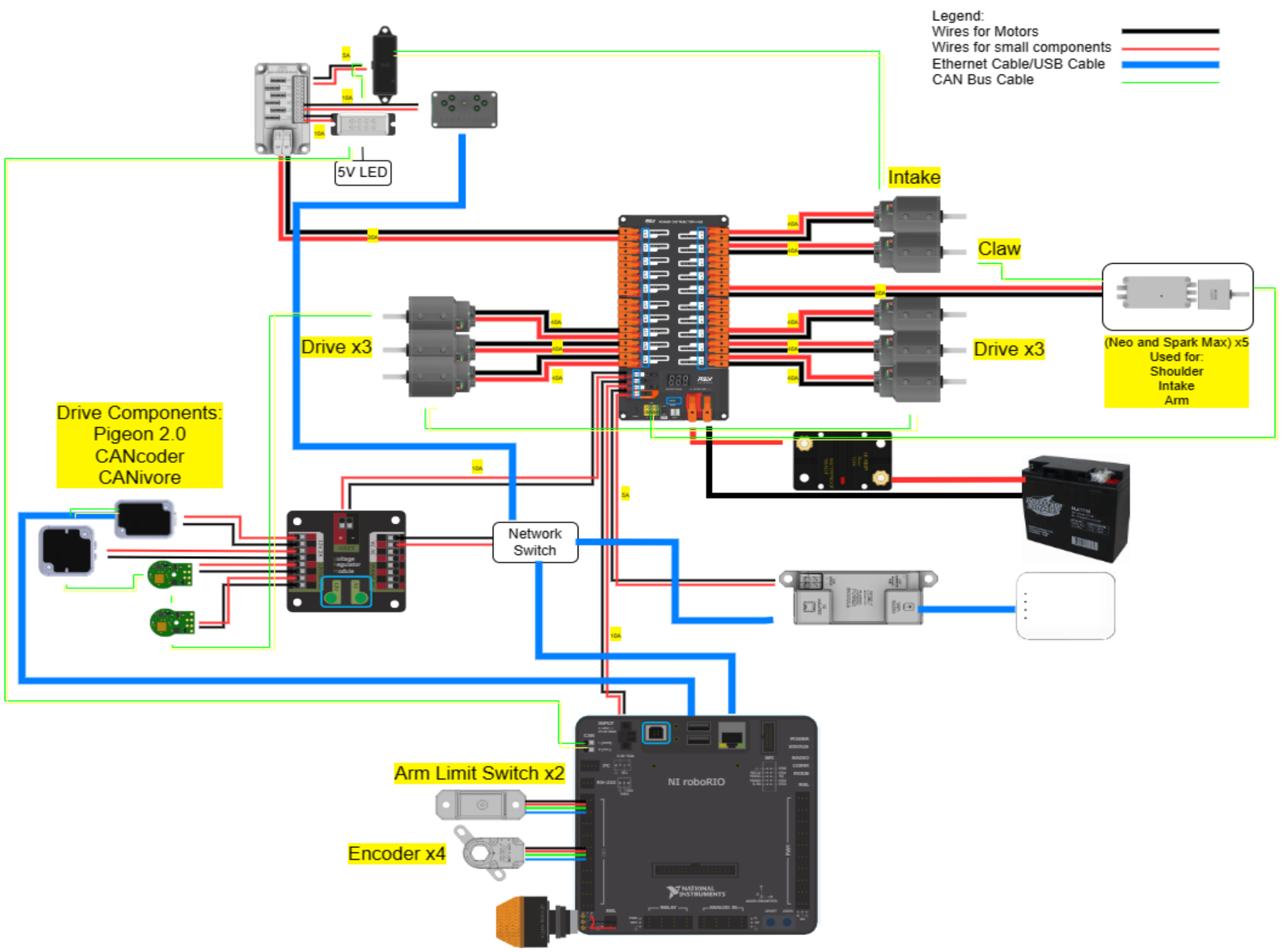
Time of Flight Distance Sensor (SEN-36005):

- *To detect the distance to game pieces, and close claws automatically when game pieces are in range.*

Through Bore Encoder (REV-11-1271):

- *To read the angle of the claws for control programs.*

ELECTRICAL LAYOUT



This year featured new challenges causing more creative ways to solve the problems. To solve the complicated problems innovative solutions had to be used with wiring the robot. Wiring through tight spaces was an issue but through the time and hours but into the attention to detail the robots wiring worked continuing the zero electrical failures streak for another year.

CONTROL SYSTEM

Input Data:

- Utilizing the on-board gyroscope, the robot can auto-balance on the charge station

- Using a Limelight, the robot is able to locate itself using the April tags on the field and detect and align with the retro-reflective strips on the cone nodes

- There is a time of flight sensor located on the claw to ensure accuracy when picking up game pieces

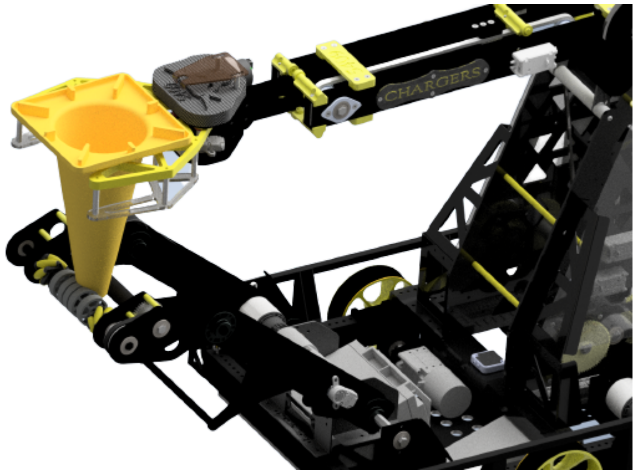
- Using encoders in the drivetrain and the gyroscope, a path can be planned for autonomous mode.

- The robot uses the information from the encoders to precisely determine the arm's current position and movement.

- An absolute encoder allows us to accurately control the grip and travel of the claw, enabling us to maintain a firm grip while also being able to move the claw to a given target position at any given time.

Output Data:

- A software process for the cone hand-off from the intake to the arm was created to minimize cycle times



- The rumble feature in the Xbox controllers are used to communicate to the drivers when a Limelight connection error occurs, allowing them to adapt their strategy and increase their awareness of the robot on the field