Enigma Design Portfolio

2024 Edition | Revised 03/2024

Table of Contents

Design Process

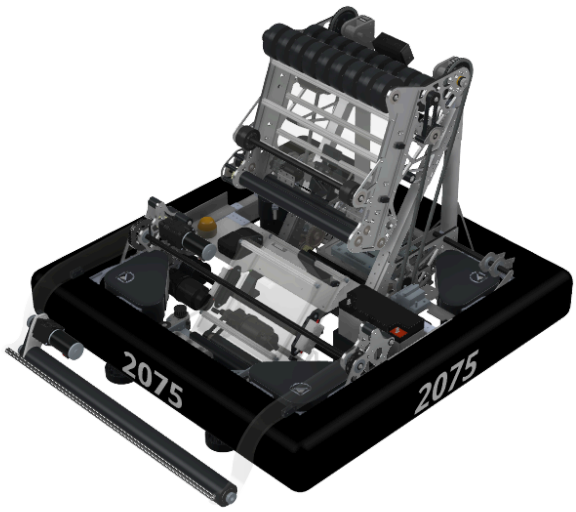
We build both **a competition and a practice bot** to facilitate synchronous design iteration and software development/driver practice. For early season development, the practice robot helps us find areas of the assembly process that could be improved, making the next robot easier to build and more polished.

Left: Practice robot | Right: Competition robot

Robot Overview

Some of our largest design requirements were:

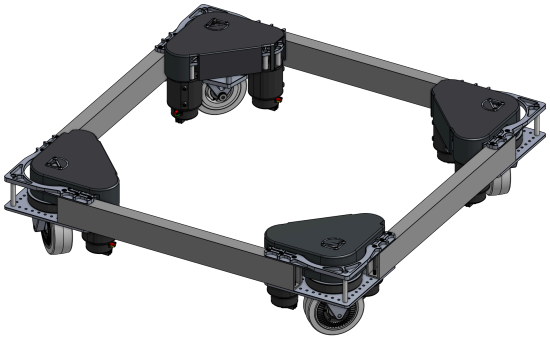
- **Low weight** (goal < 80 lbs) to achieve higher drivetrain speed
- **Low height** (<28”) to fit under the stage in stowed position
- **“Touch-it-own-it”** intake for fast cycles
- **Intake/shoot on opposite sides** for efficient autonomous routines



Robot shown in intaking position

Drivebase

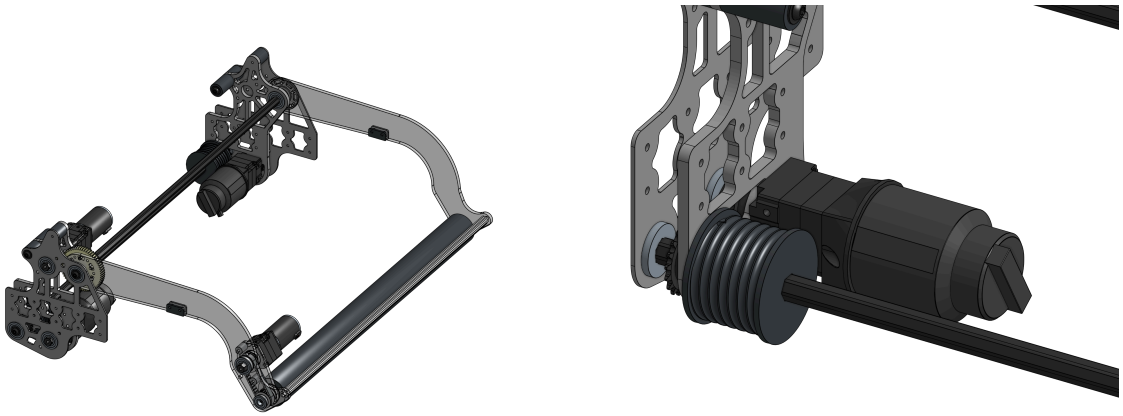
Our robot is built on a 27” by 27” **SDS drivebase**. We used the **L3 gear reduction** for increased speed, however this required designing to a lower weight limit in order to maintain acceleration. We use 4” Colson wheels for decreased maintenance during competitions.



Intake

Over the Bumper (OTB)

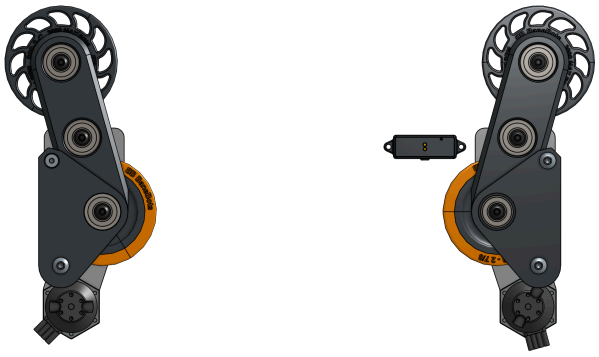
The OTB portion of the intake is designed to allow for **quick control of notes on the field**. Since the OTB intake does not pass the note off directly to the shooter, it **reduces complexity** in the hand-off process. The climber spool is integrated with this subassembly to reduce part count and weight.



Left: full OTB intake show | Right: climber spool shown

Under the Bumper (UTB)

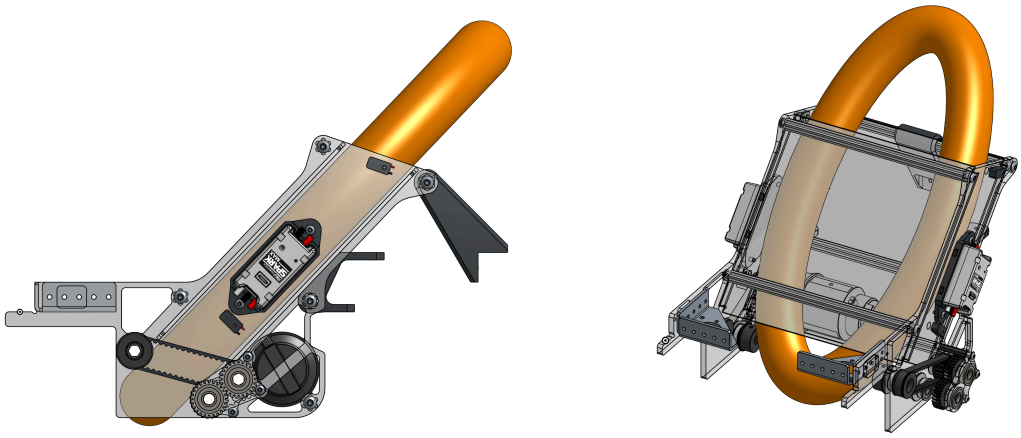
The UTB extends outside of the frame parameter during the match, but remains **behind the edge of the bumpers** to reduce potential stress on the assembly. Due to the limited space between the bumpers and the ground, the portion that extends out of the frame must be thin. To accomplish this, we use a **friction drive so that the power transmission is inline** with the intake wheels. The UBI is assisted by the OBI, but can function without it in the case that the OBI is damaged during matchplay.



Intake shown from a bottom view in the intaking position

Conveyer

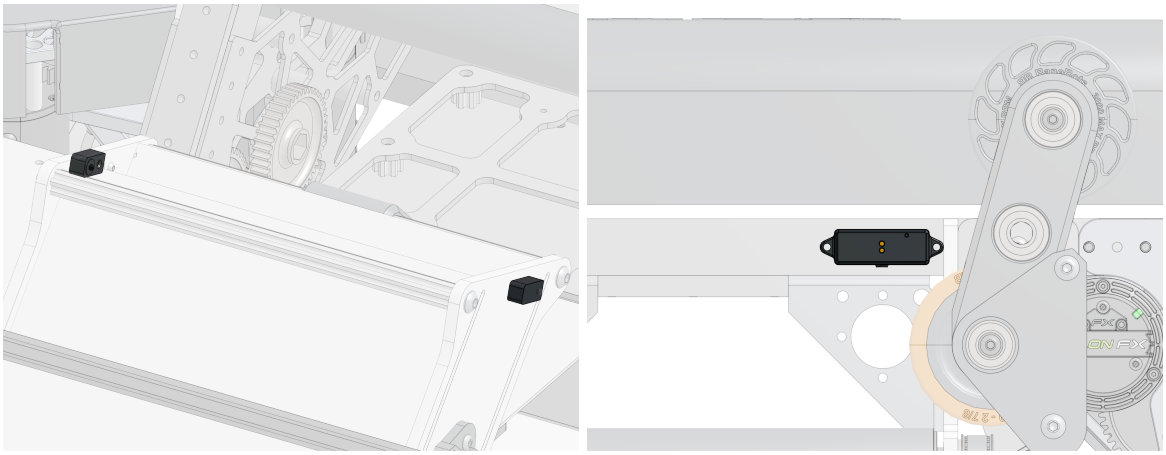
Due to the limited space between the swerve pods, the **conveyor squishes the note** as it passes through. This subassembly **hands-of directly to the shooter**.



Left: side view | Right: isometric view

Intake Sensors

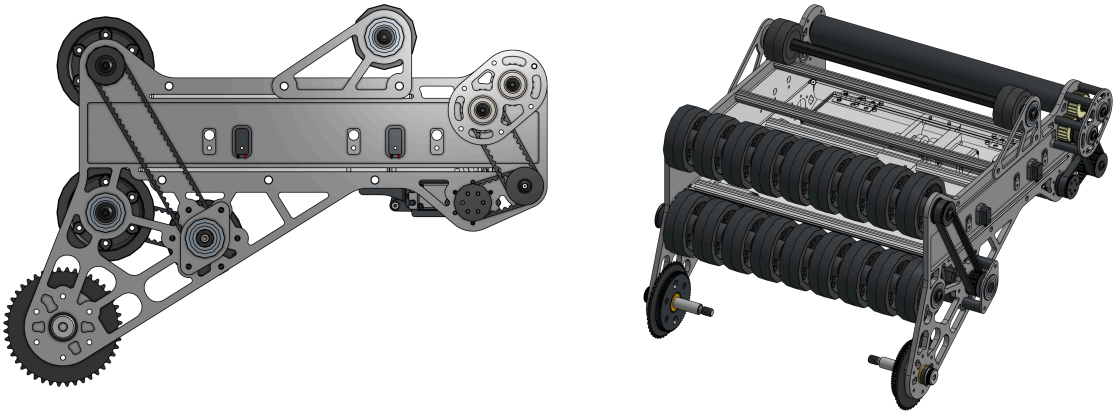
The intake has a CAN **time of flight sensor** under the driverail as well as 2 sets of **beam break sensors** on the conveyor. There are 2 additional sets of beam breaks on the shooter/feeder.



Left: beam break sensor | Right: time of flight sensor

Shooter

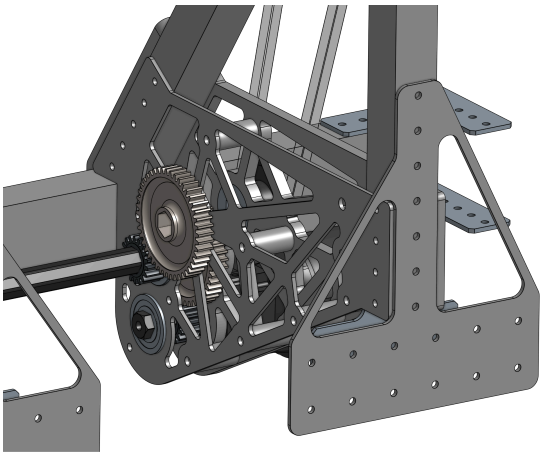
The general design of the shooter is a **double horizontal flywheel**. There is a **feeder at the base** of the shooter to feed notes when the shooter is at speed. The entire shooter assembly rotates to make shots in a **range of distances**.



Left: side view | Right: Isometric view

Pivot Gearboxes

There are **two pivot gearboxes**, one on each side of the superstructure. They are linked with a **solid ½" hex shaft** to reduce backlash in the pivot. There are also **turnbuckle tensioners** on the chain to create as much accuracy as possible in the pivot. Additionally, there is an **absolute encoder** connected to the pivot shaft directly so that shooter positioning is more accurate.



one of the two pivot gearboxes

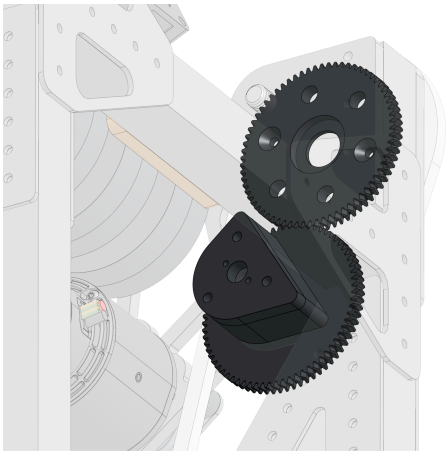
Superstructure

The superstructure is located at the back of the robot and supports the **shooter, pivot gearboxes, and climb arms**.

Image of the superstructure

Pivot Sensor

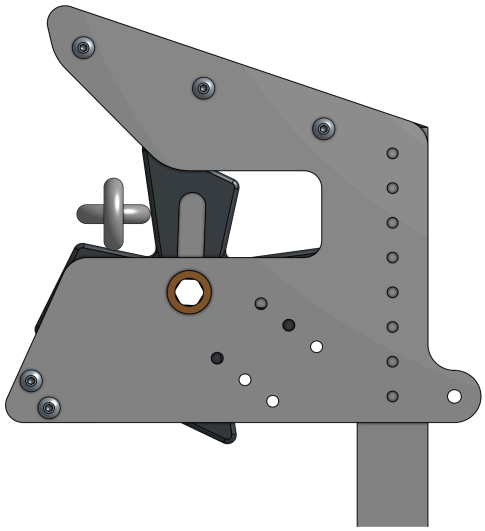
There is an **absolute position CANcoder** attached to the pivot, so that it can be precisely positioned **without worrying about and backlash** lower in the power transmission.



Isolated view of the double helical gear and CANcoder mount

Climber

The climber has **two pivoting arms** that each have **ratcheting claws**. This allows us to drive into the chain, then pull the arms the opposite direction to lift our robot.



One of the ratcheting claws of the climber, chain shown

Hardware Driver Assist Features

At the back of the superstructure A-frame there are **addressable LEDs** that are used to display **feedback to the drivers**. This includes:

- Status of a note being intook
- Shooter error(s) (ex. too far away, can't get to position, can't get to speed)