Operation Manual

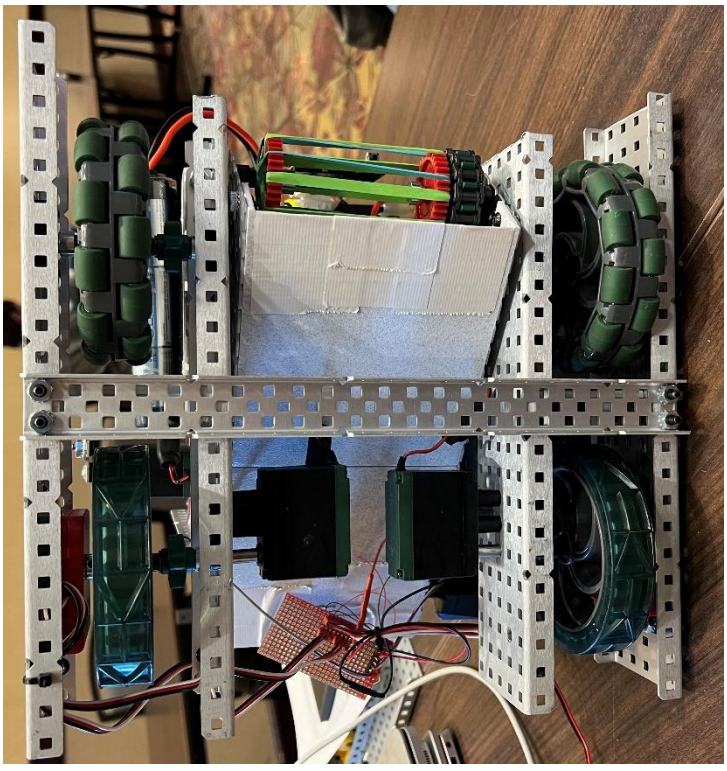
Project Overview:

The objective of this project is to design, develop, and compete with an autonomous robot that is able to pick up different astral materials (magnetic and nonmagnetic) and deposit them into bins. To optimize point scoring, the astral materials will not be sorted; they will be deposited into one container. The project aims to cohesively use mechanical, computer, and electrical engineering skills and knowledge to create a competition ready robot.

Component/Module Description:

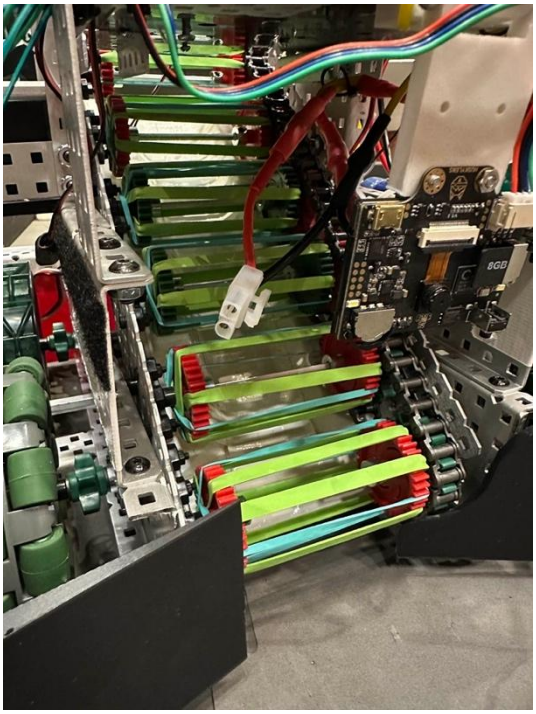
The robot can be divided into four different modules: the drive train, the collection mechanism, the ECE components, and the bin/beacon subsystems.

Drive Train:



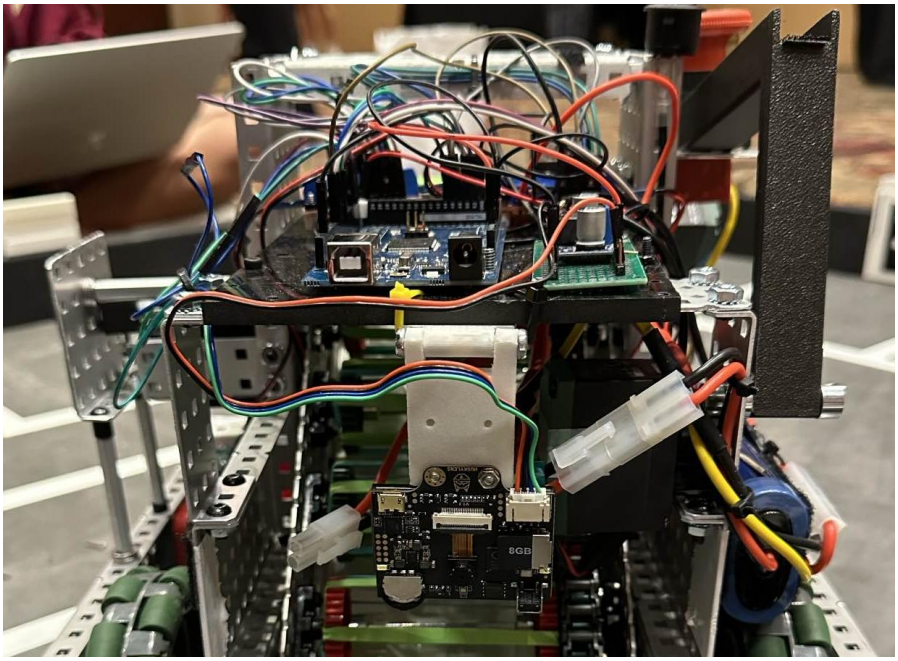
The drive train includes the two motors, 4 wheels, shafts with motor couplers, c-channels on either side of the wheels, smaller c-channels running across for stability, the front bumpers (black), and the back bumper (red).

Collection Mechanism:



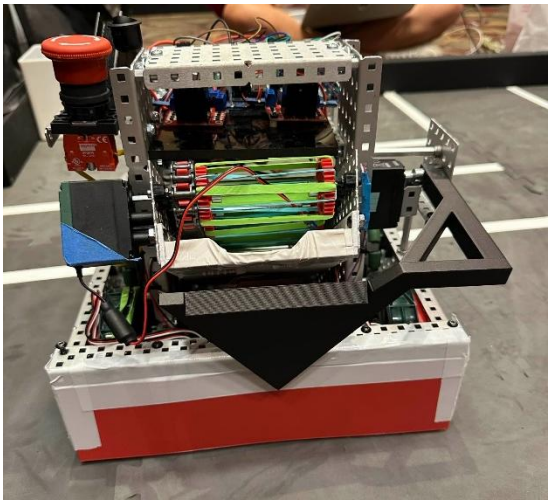
The collection mechanism consists of rubber band rollers (left picture) made using 36 teeth VEX gears. The rollers are then chained together using 12 teeth sprockets and high strength chain. A 393 VEX motor is connected to the shaft of the uppermost roller, causing all rollers to spin collectively. The rollers are placed above a PLA 3D printed ramp, which uses VEX flat plates on either side to hold the shafts in place. Spacers are used accordingly to reduce friction during motion. The entire collection subsystem is mounted between the wheel wells (right picture).

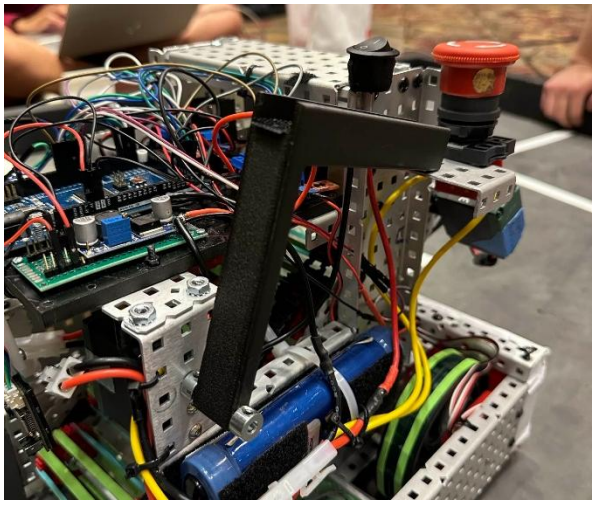
ECE Components:



The ECE components include two microcontrollers, two motor controllers, and a camera mounted onto a black plate. The black plate is mounted onto the robot above the intake via plates going up from the drive train on either side. Additionally, the side plates have the robot's batteries mounted via Velcro and zip ties.

Bin and Beacon Subsystem:





The bin and beacon subsystem includes two motors and two 3D printed arms (one per system).

Integration:

The base module of the robot is the drive train in that the other three modules are connected to it. First the collection mechanism must be placed onto the drive train via the c-channels connected to the robot. Then the bin and beacon arms along with their motors are attached to opposite ends of the train. The beacon arm is placed towards the front of the robot on the left side, and the bin arm is placed towards the back of the robot on the left side. Last the black plate with the ECE components is to be placed above the collection subsystem. It is connected to the drive train with c-channels, and it is also connected to the c-channels on the collection subsystem with plates.

Operation:

The robot has two user inputs: the on/off switch and the emergency stop switch. The on/off switch, once turned on, will power the robot and cause it to begin completing its tasks. Once turned off, the robot will completely power down and stop. If the switch is turned back on, the robot will default to its starting state rather than picking up where it left off. The emergency stop switch will completely shut off the robot if the robot is on. The emergency stop is a twist release, and it ensures a hard stop of the entire robot. Apart from those two inputs, the robot is autonomous and will run on its own.

Troubleshooting:

The following addresses possible problems that may arise with the robot and their solutions:

1. If the robot is sagging in the center (where the collection mechanism is), make sure the screws on the robot are tight and secure. The screws on the bars and plates running across the entire robot (perpendicular to the collection mechanism) will be the most important to check.
2. The rubber bands may lose strength over time, so having spare rubber bands to replace them is recommended. Slack in the rubber bands may cause issues with transporting the astral materials up the collection mechanism.
3. Having spare motors and software components (microcontrollers and motor controllers) is recommended since they can break or short circuit.
4. Make sure the encoders are spaced properly to avoid rubbing. This is because the encoders may rub against the wheels if the spacing has shifted for some reason.
5. The front bumpers may rub against the rubber bands on the front roller which will tear them. Make sure the screws securing the bumpers into place are tight. If this is still an issue, use an appropriate cutting tool to shorten the bumper as needed.