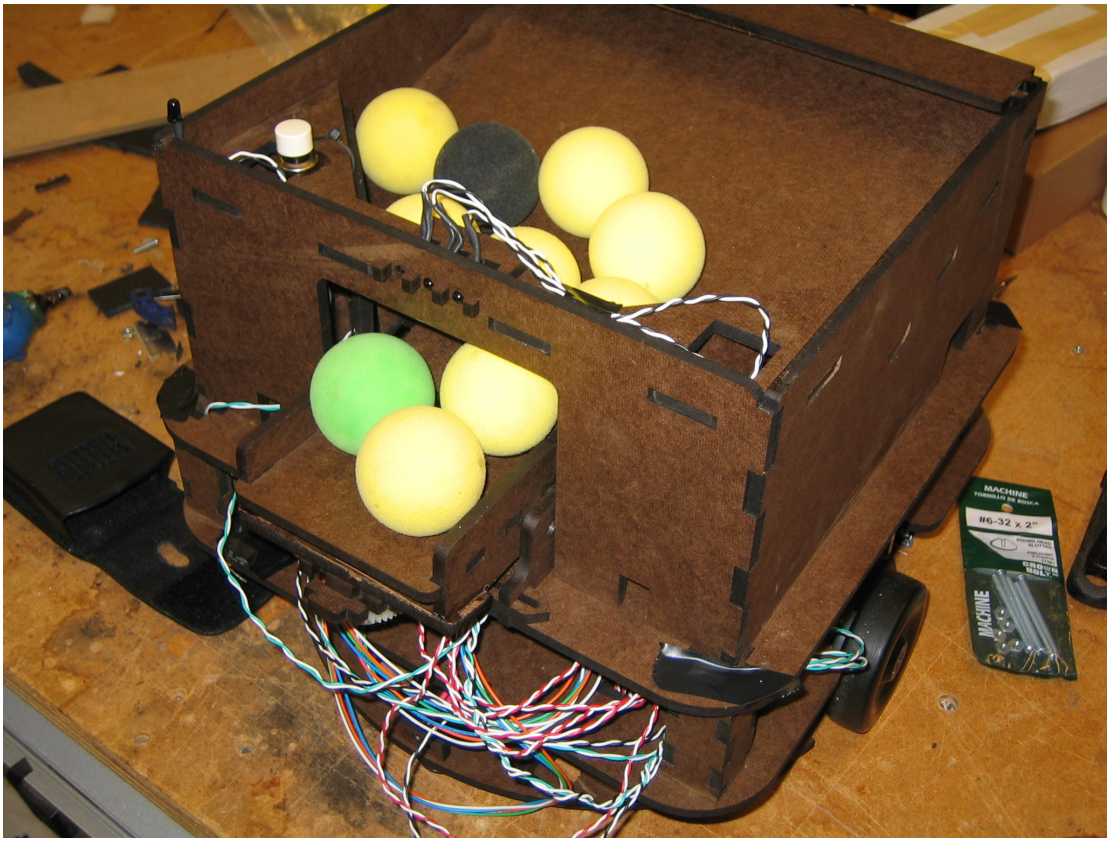
ME 218 B – Team Finesse Ezra Schiff, Mike Rode, Mark Sherwood

Mechanical Features

Outline:



I. Design Constraints and Objectives:

1. Robot must fit within 12” x 12” x 11.5” volume
2. Robot must use Maxon 110117 A-Max22 motors for movement.
3. Robot should have plenty of space for electronic components
4. Robot should be able to move with repeatability
5. Robot should be able to hold 10 Nerf balls
6. Robot should have easy access to both E128 and C32 COM ports and reset buttons
7. Robot should be able to store two large battery packs
8. Robot should provide some means of wire control

II. Design Overview

Our robot features a 3-tiered design. The first tier features a circular base, while the top two tiers feature square bases. This allows the robot to rotate when jammed in a corner as long as the wall height no greater than 3 in. (spec is 3”).

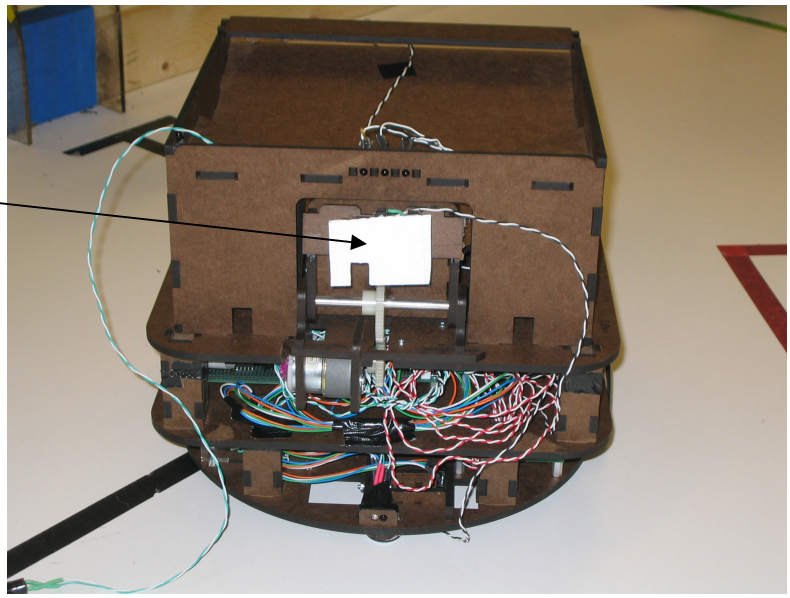
Each tier is designed to be an individual module that can be lifted and removed individually for assembly and debugging purposes.

The tiers are stacked on top of each other, supported by hollow towers. These towers allow routing wiring from one tier to the next in order to help organize the mess of wiring that inevitably develops. (These ended up helping a lot, but there were still wires everywhere!)

In addition to the computer aided design, a simple switch was glued to the front of the gate (see below) in order to detect collisions with the ball feeder. At the time the design was produced, the ball feeding mechanism had not yet been released.

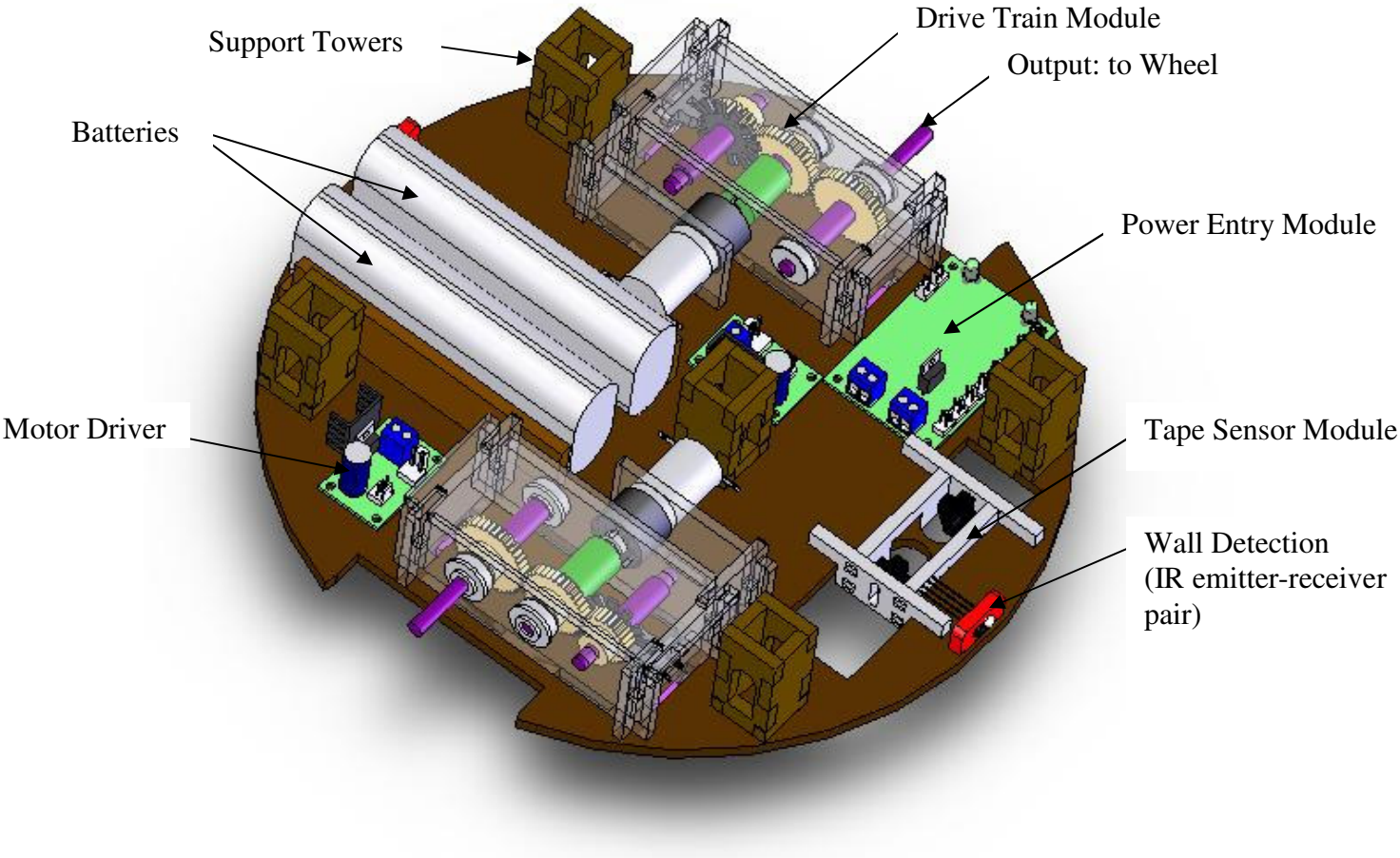
As a final note, the entirety of this robot, with the exception of the switch detecting collisions with the ball feeder) can be assembled **without requiring any adhesives.** The vast majority of components simply slide or lock into place, and only a few components need to be bolted down.

Switch to Detect Collisions with Ball Feeder



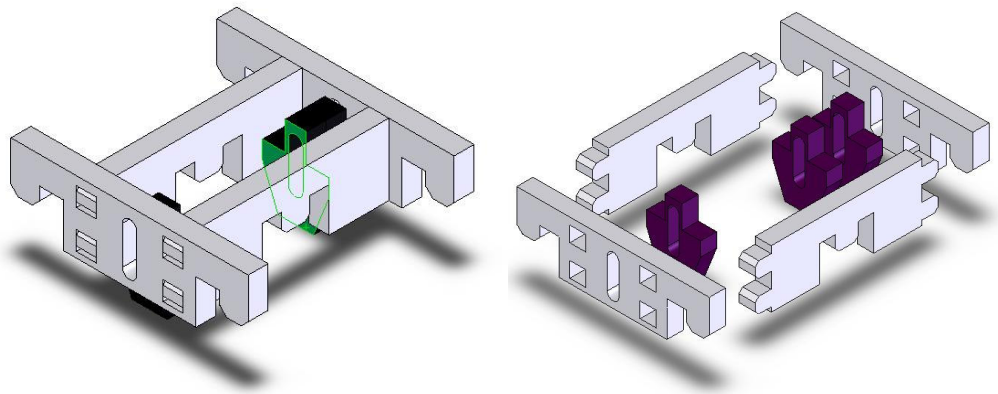
III. Base (Tier 1)

The base of the robot supports the batteries, the power entry circuit module, the tape sensor module, two IR wall detector units, and, most importantly, the drive train modules.



a. Tape Sensor Module

The Tape sensor module is very straightforward. It features 3 tape sensors, two in the middle of the robot for line following and one on the side for detecting the top of T's in the tape. All sensors are held in place with bolts *(not pictured)* that are tightened with wing-nuts to allow for easy adjustment. The walls are designed to slide into slots cut into the base.



b. Drive Train Module with Encoder

The drive train module couples the output of the motor to a wheel (not pictured) as well as to an encoder that allows precision control of the wheels' motion. In order to minimize loads on the motor, all load bearing shafts are supported by bearings.

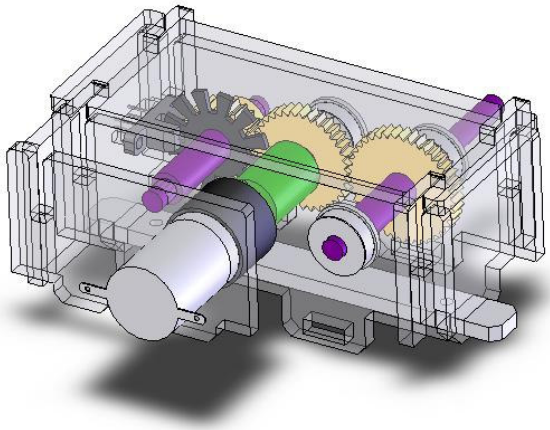
The entire assembly is supported by a long bar that mounts underneath the base of the robot and is bolted down.

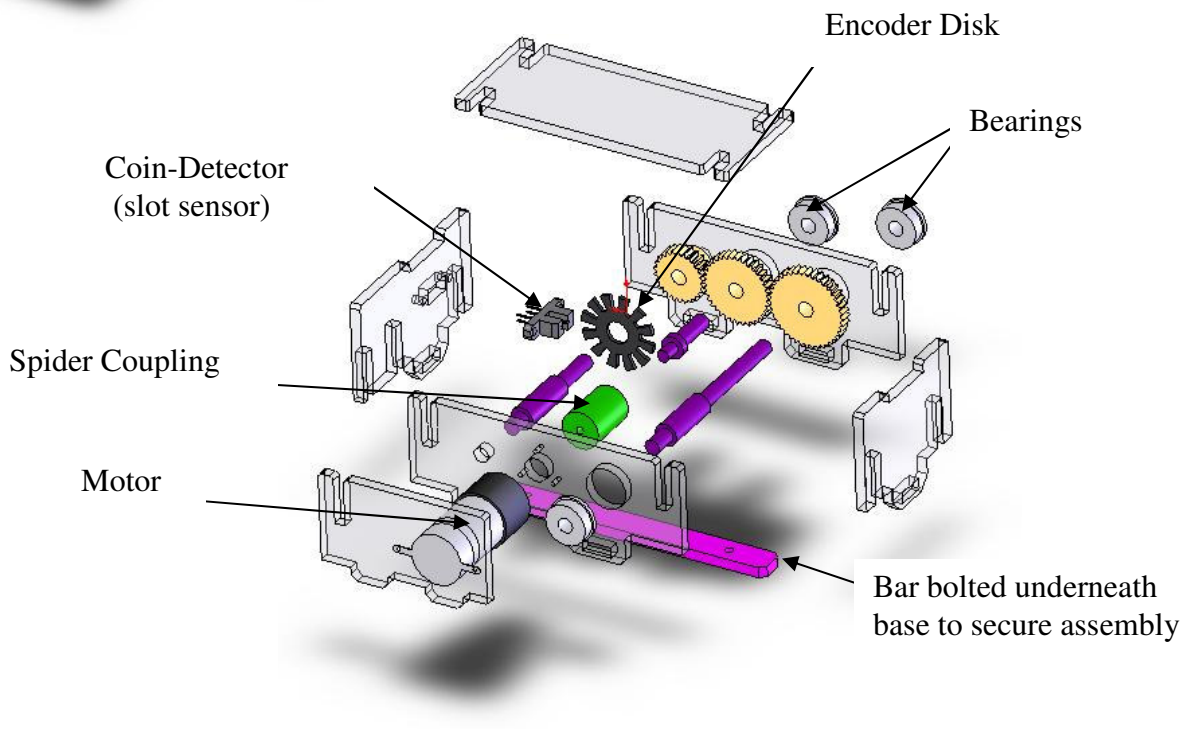
The encoder was created by mounting a spoked encoder disk *(in black)* to the smallest gear. As the wheel turns, the spokes pass through a coin-detector (slot with an IR emitter-receiver pair) and trigger the detector. Counting the number of triggers enables us to determine how far we've driven.

Note: The resolution of the encoder could have been dramatically improved, but was not done so solely due to time restrictions.

Statistics:

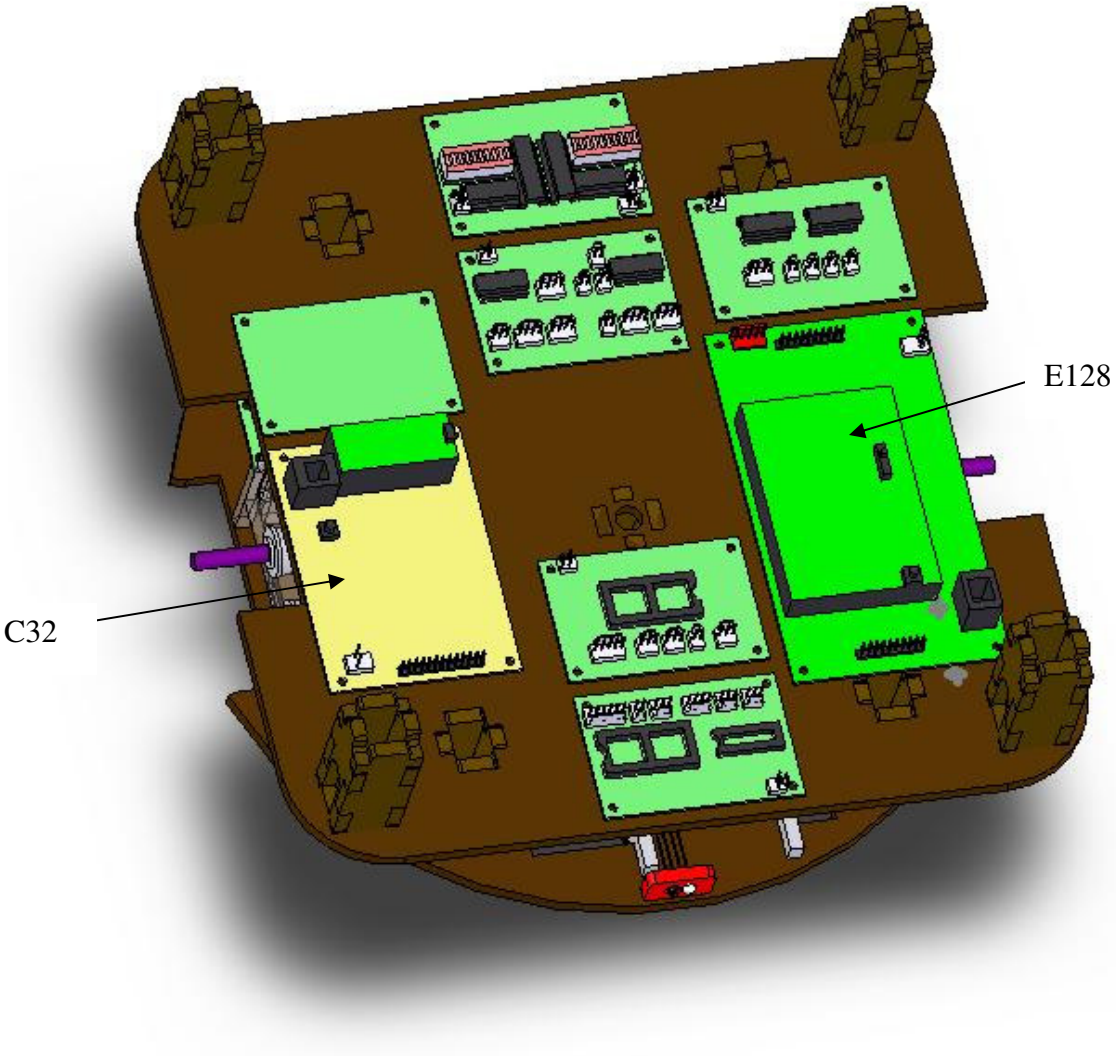
- Gear-ratio motor to wheel: **40:36**
- Encoder resolution (ticks per revolution of wheel): **18.5**





IV. Tier 2

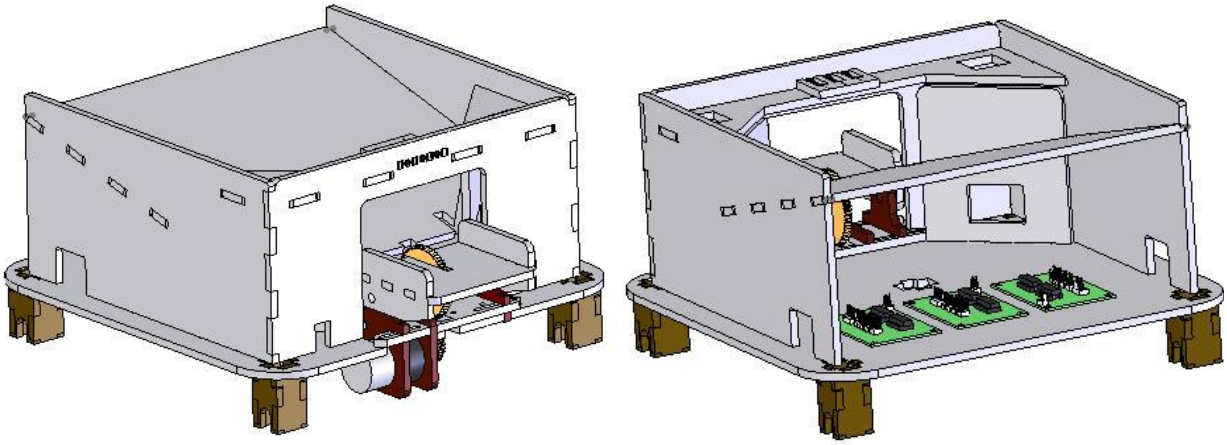
The second level was designed to support the E128, C32, and the vast majority of the other circuitry. Notice the openings where the support towers connecting this level to the base. These allow for easy wire routing between the power module, motor drivers, tape sensors, etc. below and the E128, C32, and other circuitry above.

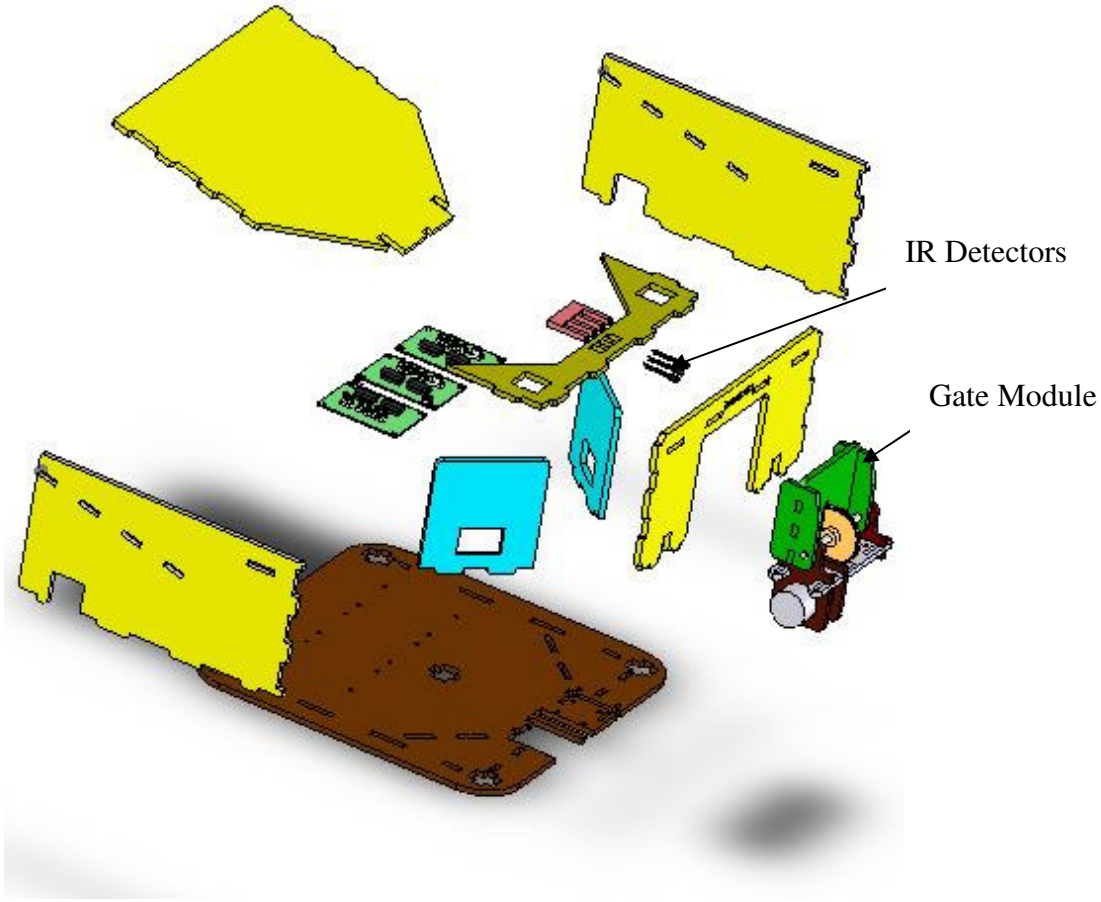


V. Hopper (Tier 3)

The hopper has no problem holding ten balls, and features a geared drawbridge-style gate that is actuated by a geared DC motor (Jameco P/N: 253534). To prevent balls from jamming at the gate as they exit, we added a small vibrating DC motor (not pictured) that turns on when the gate is opened.

In addition to these features, three IR detectors are mounted to the front of the hopper. The middle detector is used to compute beacon duty cycles while the two on the sides are used to aid the robot in tracking a beacon.





a. Gate Module

The Gate Module was designed to smoothly and efficiently unload balls. The geared motor used to open and close the gate outputs far more torque than necessary, however this ensures allows the gate to open smoothly without slamming into any of the hard stops.