
To: John Ridgley

From: Logan Femling, Kristofer Lee Pascua, Sanjay Menon

Date: 2/2/2024

Subject: Term Project Preliminary Design

This memo includes preliminary details of our design for the ME 405 Term Project for Winter Quarter 2024. The final product will be a turret which tracks heat-generating objects and launches foam projectiles at said objects. It will require closed loop control in order to accurately move, aim, and launch the projectiles.

Launching of the projectile will be accomplished with a pair of counter-rotating flywheels, whose high speed of rotation will accelerate the projectile forward. These flywheel motors will be 12V brushed DC motors run with open-loop control. The projectiles themselves will be “half-darts”, which are similar to typical Nerf brand foam darts, but with a reduced length. The reduced length makes the darts more aerodynamic, reduces their mass, and makes the launching system more compact.

The projectiles will be stored in a spring-loaded removable magazine. This will eliminate the need for reloading between dueling rounds. The darts will be pushed from the magazine into the flywheels using a small, brushed DC motor with a gearbox. The motor will rotate a crank-slider mechanism, which provides the needed linear motion to push the darts forward. This pusher-motor will be run without encoder feedback but will have a mechanical limit switch to detect a full revolution, indicating a singular dart launched.

The singular axis of rotation used to aim will be accomplished by a singular 12V brushed DC motor with encoder feedback. The motor will rotate a platter using a set of gears. The launcher system will be mounted to the platter, along with the infrared camera. The platter will be rotated using a control loop until the intended target is aligned with the center of the camera view. The launcher will be mounted using a fixed, but adjustable angle. This will allow us to compensate for any drop in altitude the dart may experience on its voyage across the room.

We feel that given the rules of combat associated with this project that only a single aiming axis is necessary, since an opponent will be at a roughly constant distance from the turret and is required to remain standing.

Please see the attached documents for diagrams and CAD models for the current design.

Note that this design is subject to change as we learn more about the capabilities of both ourselves and the Nucleo STM32.

Parts of significant importance to the function of this design are attached in the Bill of Materials.

Attachment A: Currently Modeled Subsystems

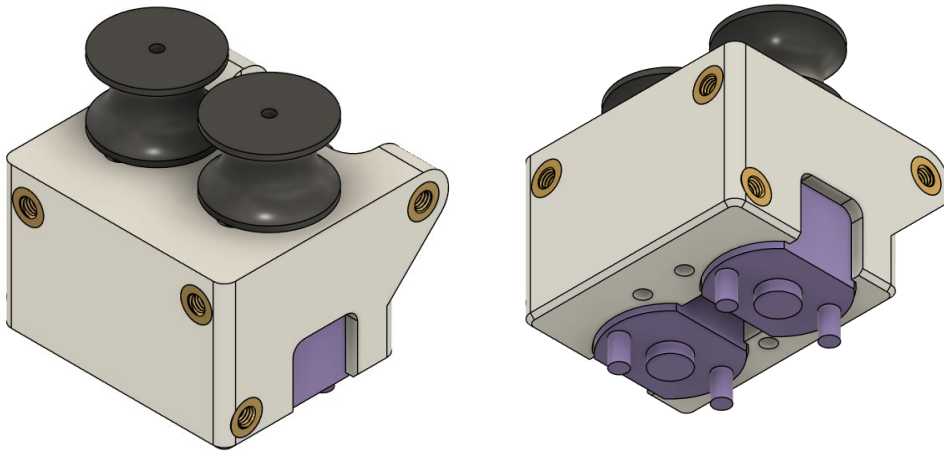


Figure 1: Flywheel Cage Assembly. The motors are wired to counter-rotate, and the flywheels accelerate the dart as it passes through, launching out of the barrel.

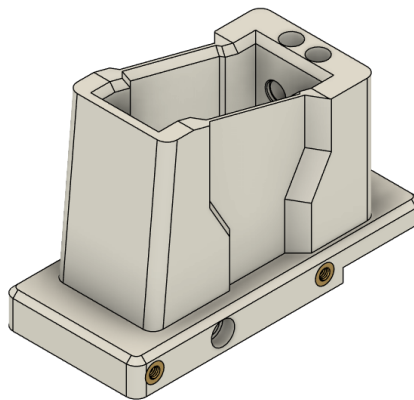
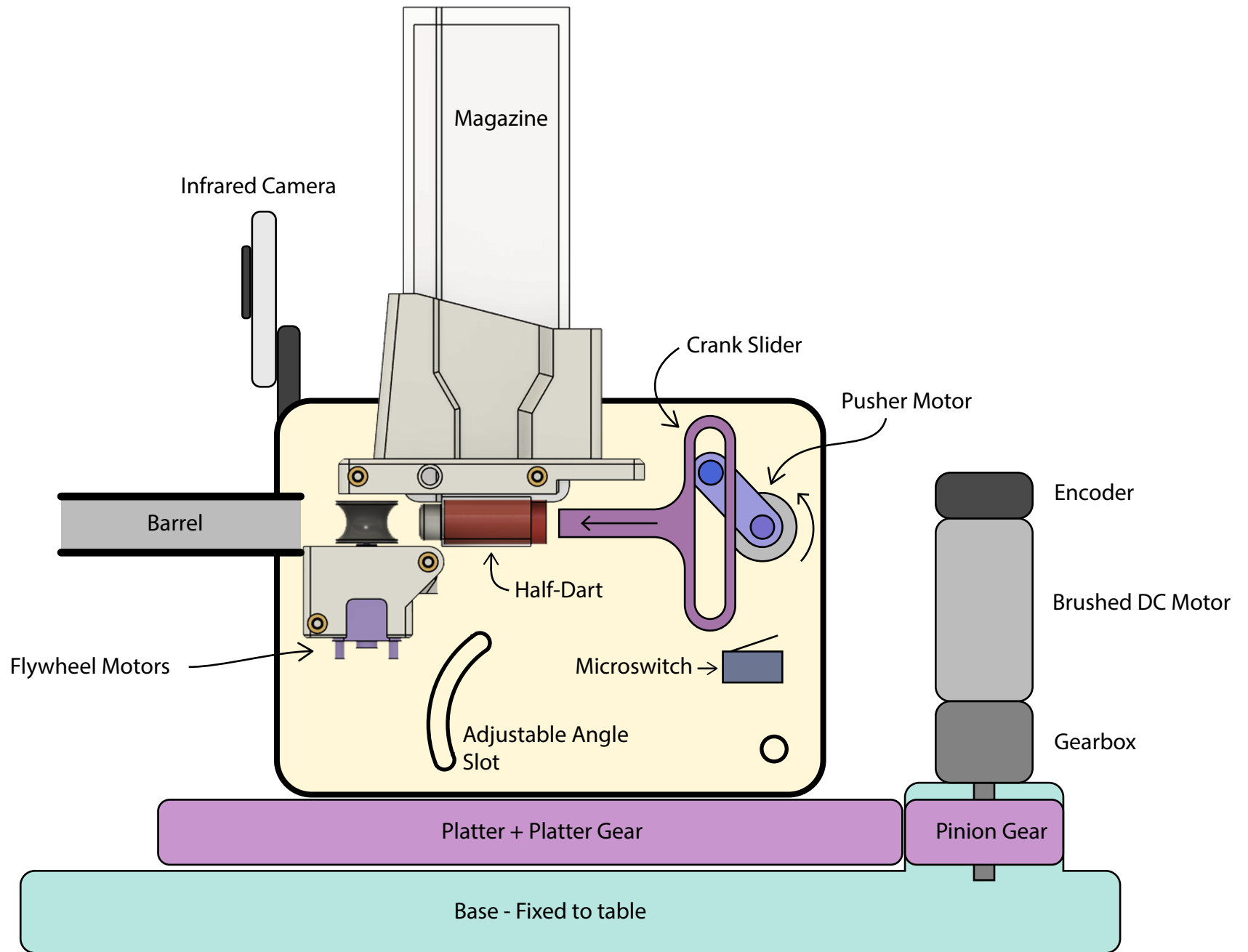


Figure 2: The magwell interfaces with the Off-The-Shelf removable magazine. The magazine is retained with a ball detent.

Attachment B: System Design Layout



ME 405 Lab Term Project - Team 09 Preliminary BOM

Vendor	Product Name	Part Number	Product Hyper Link	Qty	Price/Ea	Total
OutOfDarts	Loki 3s 130 Brushed DC Motor		https://outofdarts.com/products/loki-130-3s-high-rpm-	2	\$8.50	\$17.00
	Worker 10 Round Short Dart Magazine		https://outofdarts.com/products/worker-10-round-talc	1	\$9.00	\$9.00
	Worker Nightingale Flywheel Pair		https://outofdarts.com/products/nightingale-flywheel-p	1	\$9.00	\$9.00
	N20 Metal Micro Gear Motor 300RPM		https://outofdarts.com/products/n20-metal-gear-moto	1	\$6.00	\$6.00
	1A Microswitch		https://outofdarts.com/products/micro-switch-1a-for-r	2	\$0.80	\$1.60
Polulu	12V 50:1 Metal Gearmotor with Encoder		https://www.pololu.com/product/4753/resources	1	\$51.95	\$51.95
Amazon	Deep Groove Ball Bearing 80x100x10mm		https://www.amazon.com/uxcell-6816-2RS-Bearing-80x100x10mm/dp/B07K9K9K9K	1	\$13.99	\$13.99
Total:						\$108.54