

MEMORANDUM



To: Charlie, Lecturer, Department of Mechanical Engineering, Cal Poly SLO
crefvem@calpoly.edu

From: Vinh Vo
vvo11@calpoly.edu
Jonathan Lam
jlam94@calpoly.edu

Team: MECHA8

Date: < 04/15/2024 >

RE: < Proposal for ME 507 Final Project: Basketball Launcher >

1. Memo Proposal

Our project for ME 507 involves the design and implementation of a basketball launcher, aimed at launching basketballs of 5 inches. The system is operated via a glove equipped with an Inertial Measurement Unit, facilitating hands-free control and command transmission to a custom PCB.

The glove integrates a Bluetooth module, housed within a standard STM32 black pill, enabling wireless communication in compliance with project requirements. Additionally, an emergency stop (E-stop) feature is integrated into the glove and IMU, allowing instantaneous override of commands. The custom-designed PCB serves as the heart of the system, providing closed-loop feedback to the IMU for continuous updates of launch coordinates, thereby fulfilling the requirement for a closed-loop feedback system. The system incorporates two stepper motors: one for adjusting the launch angle and the other for controlling the yaw angle, thus meeting the criteria for at least two actuators. The second actuator, situated on the launcher itself, comprises a BLDC motor attached to a wheel, which, upon receiving the launch command from the IMU, propels the basketball. To satisfy the requirement for two unique sensors, besides the IMU, two limit switches are installed on both axes to prevent the motors from exceeding a 360-degree rotation and ensure that the motor controlling the height angle does not collide with the enclosure's bottom, mitigating potential damage and adhering to safety protocols. Furthermore, the E-stop feature on the glove provides users with a safeguard against potential harm, aligning with safety regulations and preventing the robot from causing harm to individual.

2. Manufacturing Plan

Table 1. Requirements Fulfil

No.	Requirement	Description
1	2 Unique Actuators	2 NEMA Stepper (might change to DC Motors) & 1 BLDC Motor for ball launching
2	2 Unique Sensors	1 IMU to control the desired angle + 2 limit switches for safety and home location + Bluetooth module + (2 encoders in case using DC motors instead of steppers)
3	1 Closed Loop Controller	1 IMU angle feedback for motors control
4	Wireless Controlled	Bluetooth communication between controller and the launcher
5	Customized PCB with STM32	Using BlackPill for the controller & STM32F411CEU6 Chip for the launcher
6	Power	12V to power the launcher, 3.3V to power the controller
7	E-Stop Switch	E-Stop is in the controller. In case malfunction, the switch will cut the connection of the BLDC immediately

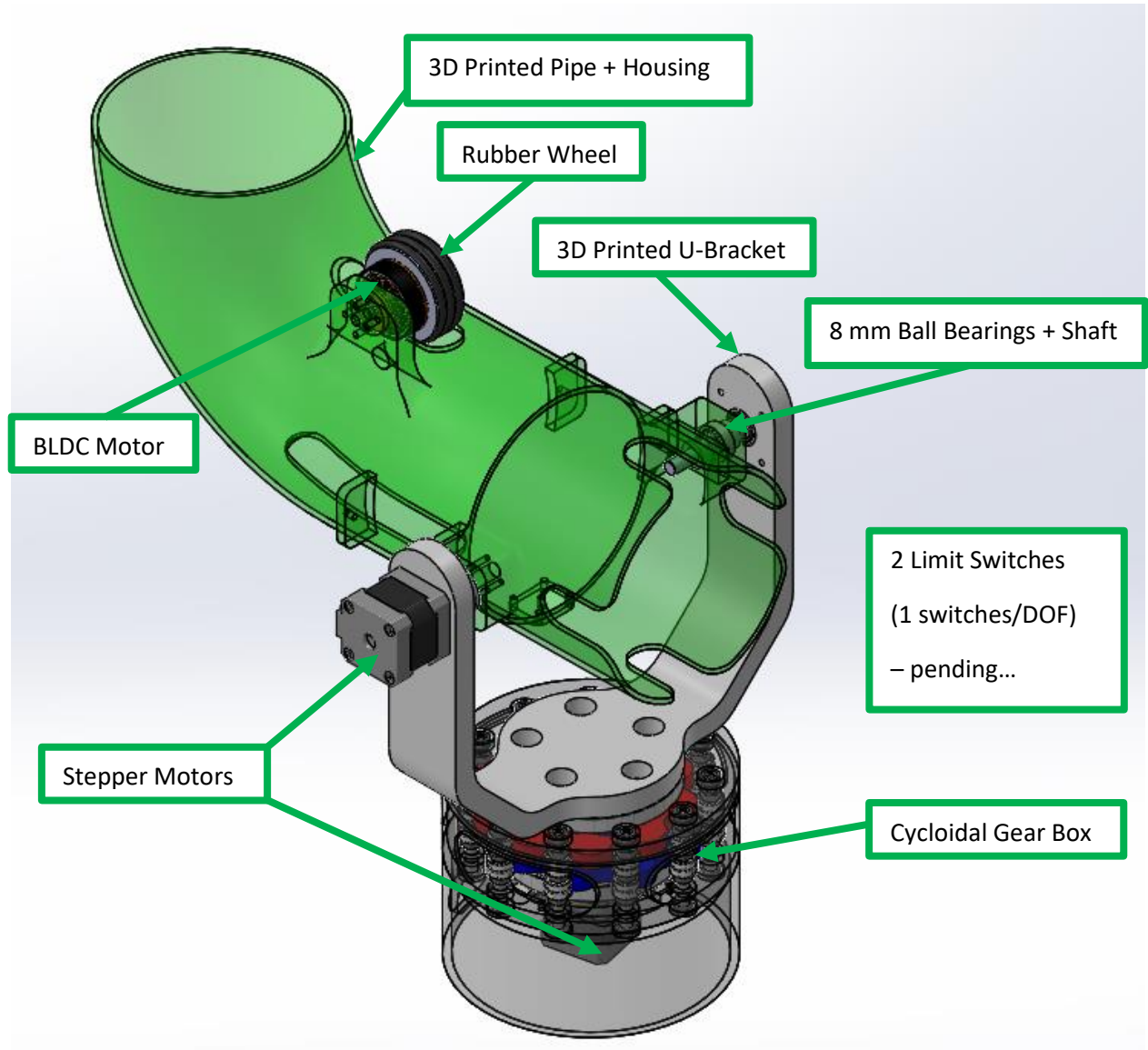
Table 2. Manufacturing Plan

No.	Parts	Description
1	Motors	All motors are mounting in 3D printed brackets with M3 fastener
2	Housing	All housings or brackets are 3D printed using PLA or ABS
3	Fastener	Except for the cycloidal gear box, all the fasteners are M3 size
4	Shaft	The 8 mm shaft will be installed in the housing holes and secured by 8 mm screw-set collar. Rotations is supported by also 8 mm ID ball bearings to reduce friction
5	Bearings	There are about 5-6 ball bearings that are press-fit into the 3D printed housing to support the rotation of the shaft
6	Gear Box	The gear box is prebuilt from a personal project that contains M6 bolts and M6 lock nuts for secure the 6 mm ID ball bearings inside
7	Control Glove	All electronic components on the glove will be placed in a small enclosure and attached to a normal glove using hook & loop heavy duty tape
8	Electronics	All the electronics communication details are described in wiring diagram below. The PCB and electronics components will be soldered together from 118 lab's equipment

3. Bill of Materials

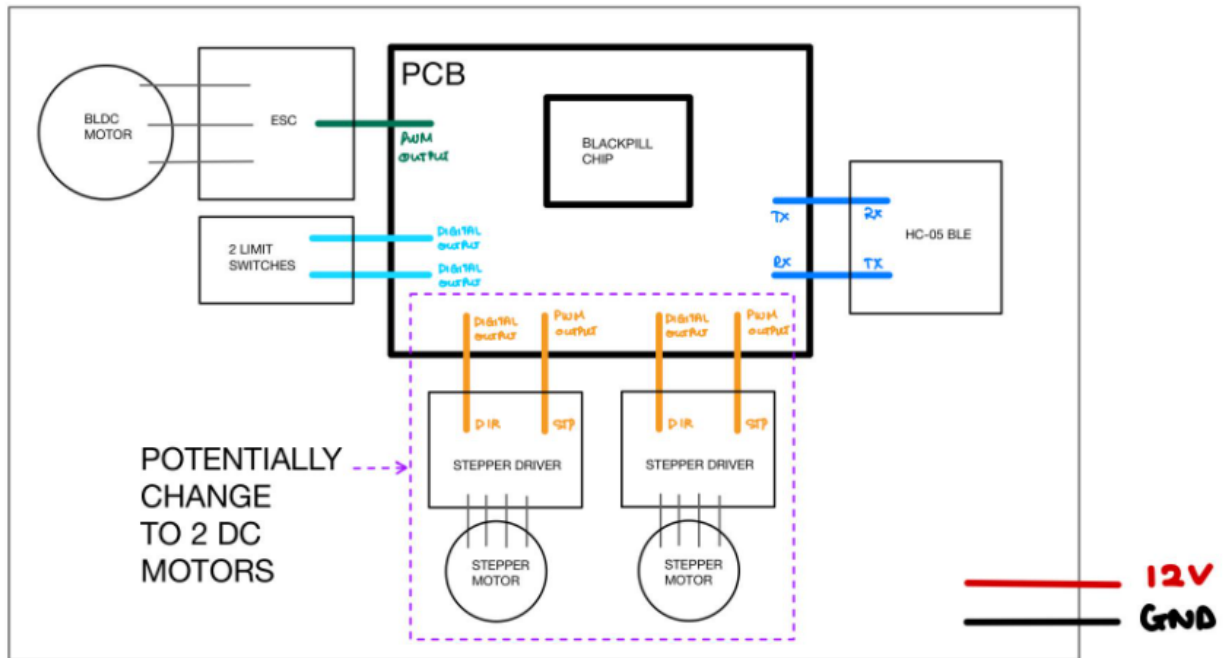
BOM					
Product	Picture	Number part	Amount	cost(\$)	status
NEMA 17 stepper motors		NEMA17	2	\$30	bought
D4215 brushless Motor		D4215	1	\$26	bought
Motor Driver (stepper motor)		DRV8825 or TB660	2	\$20.00	bought
Brushless ESC		DT-30A	1	\$22	bought
IMU		MPU6050	1	\$8.59	not yet
STM32 "Black Pill"		F411CEU6	2	\$29.95	not yet
Limit switch		Pending	2	\$3.50	not yet
Bluetooth Module		HC-05	1	\$10.39	bought
Cycloidal Gearbox		N/A	1	N/A	own
PLA		Bambu Lab	2	\$36	bought
			Total	\$186	

4. CAD



5. Wiring Diagram

LAUNCHER



CONTROL GLOVE

