Flipping system idea: <https://connbots.weebly.com/blog/a-1-lb-spring-powered-flipper-the-complete-journey>

Different Motor/Spring Combinations

| Aspect | Servo Motor + Spring | High-Torque DC Motor + Spring |
| --- | --- | --- |
| Motor Model | Continuous Rotation Servo (e.g., FEETECH FS90R or Parallax 360° Servo) | High-Torque 360° DC Motor (e.g., Mabuchi RS-775 with planetary gear) |
| Torque | ~1.5 kg-cm to 5 kg-cm (depending on model) | 10-20 kg-cm (with gear reduction) |
| Rotation | Continuous 360° rotation (can rotate infinitely in either direction) | Continuous 360° rotation with gear reduction and limit switch or encoder for control |
| Spring Model | Torsion Spring | Compression Spring |
| Spring Constant (k) | 5-10 N·m (depending on flip force required) | 15-20 N·m (depending on heavier flip needs) |
| Precision | Moderate precision; pulse width modulation (PWM) control of speed rather than angle | Requires limit switches or rotary encoder for precision |
| Force and Speed | Moderate flipping force; lower torque compared to DC motor | High flipping force; slower speed, but more torque |
| Ease of Control | Easy to control with PWM, but position control is challenging (good for speed adjustments) | More complex control with motor controller and feedback mechanisms |

If we want **simple control** without needing high torque, a **continuous rotation servo** with timing might be a good option, but it will lack precision.

If we want **precise control** and **higher torque**, a **high-torque DC motor** with a **rotary encoder** is the best choice, as it will allow for accurate control over the 360° rotation and stopping points.

* We want this, BUT to implement a rotary encoder, we’d need a sensor and disk, and that sounds really hard
* Another good option: use a high-torque servo motor that can stop precisely after 360 degrees
  + No external sensors:
    1. Unlike DC motors, **servo motors** have built-in control electronics, so you don’t need an external rotary encoder or additional sensors to track position.
    2. The servo motor's internal feedback system ensures that **it can rotate a set amount (like 360°) and stop precisely.**
  + Precise rotation control:
    1. With **360° continuous rotation servos**, we can control the motor to spin exactly 360° and then stop.
    2. This allows you to control the flipping mechanism without needing extra hardware for position tracking.
  + High Torque:
    1. There are high-torque servo motors available, such as the **Power HD 1235MG High-Torque Servo**, that can generate sufficient force for flipping.
    2. These motors can also be programmed to handle the rotation requirements of your flipping mechanism.
* We can program the servo to rotate the required 360°, compressing the spring, and then stop. When the flip is triggered, the spring would release, performing the flipping action.
* Once the action is complete, the motor could reset to its original position and be ready for the next trigger.
* Example
* **Servo:** Power HD 1235MG High-Torque Servo (supports continuous rotation and high torque).
* **Control:** Can be controlled directly with a **PWM signal** from a microcontroller (ESP-32 has one), which allows precise control over when and how much the motor rotates
* Advantages
  + **Simplified Setup:** No need for rotary encoders or limit switches.
  + **Built-in Feedback:** Ensures that the motor rotates and stops as programmed, without external sensors.
  + **High Torque:** Many 360° servos can provide sufficient torque for flipping mechanisms, especially when paired with a compression spring.

#### **a. Savöx SC-1256TG – $84 way too expensive**

* **Torque:** 0.24 N·m (33.3 oz-in) at 6V
* **Speed:** 0.15 sec/60 degrees
* **Notes:** This servo is a standard-sized servo, and although it doesn’t meet the torque requirement, it can be used with gear reduction.

#### **b. Dynamixel MX-28T**

* **Torque:** 2.5 N·m (352.5 oz-in) at 12V
* **Speed:** 0.229 sec/60 degrees
* **Notes:** This servo is programmable and suitable for robotics. It can easily handle the torque requirement.

#### **c. Hitec HS-7950TH**

* **Torque:** 0.57 N·m (80 oz-in) at 6V
* **Speed:** 0.12 sec/60 degrees
* **Notes:** While slightly below the required torque, it can also work with gearing or leverage.

#### **d. Robotis Dynamixel XL-430-W250 -> doesnt work only 0.28NM**

* **Torque:** 2.5 N·m (352.5 oz-in) at 12V
* **Speed:** 0.23 sec/60 degrees
* **Notes:** This is a robust servo suitable for high-performance robotics applications.

When selecting a servo motor, consider the following:

* **Operating Voltage:** Ensure the servo can operate at the voltage supplied (6V to 12V).
* **Size and Weight:** Consider the weight and space available in your battle bot.
* **Control System Compatibility:** Make sure it can be easily controlled using your existing electronics (e.g., ESP32).
* **Durability and Reliability:** Choose a servo that can withstand the rigors of battle bot competition.