The reaction wheel is an electrical mechanical device used in machines that requires a rotation or alignment along a specific angle. The reaction wheel is heavily focused in the rockets, spacecrafts, and satellites where constant adjustment along the position of the machine is required, but fuel sources are limited as known with propellent (Teitel). The general concept of the reaction wheel is straight forward, the device has about 3 motors that are placed within the structure of the device, and these motors are placed at different angles othogonal to each other. The motor’s function is to speed an attached disk at specific revolution per minute (RPM) produce the sufficient torque needed along the x, y, z axis, to orientate reaction wheel to the specify angle of space.

The reaction wheel is heavily dependent on the motors implemented for the torque production. Because this technology will have no external force acting on the body of the device, the reaction wheel has no way of maneuvering in a vacuum. Understanding the principal of physics, can apply the concept of torque and angled forces onto the motors, where we can calculate for the RPM needed to produce the necessary torque needed to rotate the reaction wheel in a frictionless space. While there plenty of equations, and documents on the math behind calculating for RPM needed on the motors, it is a section that the team hasn’t looked into yet. Yet, that is not a barrier in our progress. Currently, we understand which components needed for this project, and the general idea on how to implement concept, specifically, we understand that we will need a brushed motor with an embedded encoder (or externally implemented encorder) that we can measure and calculate the acceleration needed to apply the necessary current to match the rpm needed for the specific torque. Due to the moment of inertia, the motors will need a fly wheel to produce any sufficient torque, and during our research and trials, we found that brushless motors such as those found on drones, will not work properly for this project. As Tom Stanton stated in his video, the torque output from the brushless motors are not linear, and as a result, it will make it difficult to tune the paraments in the controller.

Using Arduino as the microcomputer that process signals and information.

In a technical document written by Ricardo Gomes, Gomes provided a critical analysis about the performance of a reaction wheel he had worked on designing and developed, along the other critical information, one section that needed to be emphasized is the configuration for minimum energy consumption. Gomes stated that the most optimal angle for minimum consumption is 45 degrees and 60 degrees from the y axis, or an axis of a satellite, “ the goal is now find the optimal angle β1 and β2 that minimizes the power consumption of the system… β1 = 45◦ and β2 = 60◦ .” Because resource consumption is a key point of focus, for any remotely controlled devices, this provided angle can greatly optimize the reaction wheel for various scenarios where power production is disabled, however, it’s not something that would make or break the project.

Citations

<https://www.youtube.com/watch?v=4kfBEaTncjI&t=1008s> (Tom Stanton)

<https://fenix.tecnico.ulisboa.pt/downloadFile/844820067125118/ExtendedAbstract.pdf> (Ricardo Gomes)