SELF ASSEMBLING CUBES

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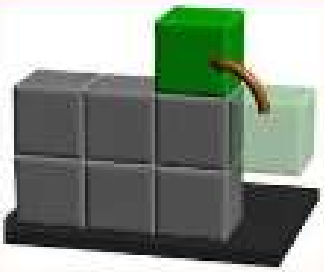
Abstract



The project aims to develop a series of self-orienting cubes capable of assuming any desired 3D orientation. These cubes operate on the principle of conservation of angular momentum, using **reaction wheels** that rotate at high speeds followed by braking, thereby inducing rotation in the desired direction. Such cubes hold potential applications in various fields such as robotics where precise orientation control is essential for tasks.

Design

The frame of the cube is divided into 3 layers one for the **battery pack** and the **ESC** controller, one for the braking pad system. The 4 frames are supported by long screws along 4 edges. This is to ensure minimal weight for enclosure and easy maintenance of the cube.

Movement

The motion mechanism of self-assembling cubes relies on a system centered around an ESP32 microcontroller, which receives real-time acceleration values externally. Using this data, the ESP32 communicates speed values to a BLDC motor connected to a reaction wheel mechanism. The BLDC motor rotates the reaction wheel at a high speed, harnessing the principle of conservation of angular momentum.

When the reaction wheel spins, it generates a torque that counteracts the cube's existing angular momentum, causing it to rotate in the desired direction. By precisely controlling the speed of the BLDC motor, we achieve rotation.

Braking

Braking is done for the purpose of rotating the cube. The wheel is first driven to attain a high rotatory speed. The angular momentum of the reaction wheel is converted to torque by means of a frictional surface that comes in contact with the wheel. The braking pad surface contact is regulated by a servo motor which moves it.

Code

The cubes' movement will be orchestrated by an ESP32 microcontroller, with speed values generated by OpenCV to ensure precision. The motor speed will be dynamically regulated in accordance with these instructions, facilitated by continued motoring system via a camera placed above the system.

Future plans

Streamline the motion of the reaction wheel, enhancing its efficiency and reducing its size. We plan to automate the cubes further by using OpenCV. Additionally, we aim to utilize multiple cubes to create complex structures. Moreover, we're exploring the potential to extend the movement capabilities of the cubes beyond simple linear motion into 2D and even 3D space.