CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

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Project Number

S1814

Project Title

Control of a Free Swinging Pendulum by the Force Created by Rotor Inertia

Abstract

Objectives/Goals

My project's objective was to figure out how inertia can be controlled, how it can be eventually used as a mechanism for balancing robots. This project looked for how much inertia can have an effect upon an object, the free swinging pendulum, and get the equation for it. It also looked for the most efficient method to maximize the amount of inertia created.

Methods/Materials

In order to demonstrate the power of inertia, the swinging time of the pendulum were used to compare the different variables. A disk was attached to the end of the pendulum, which was spun by a motor in order to create inertia. Experiments were done by using an IMU sensor to measure the angle. The control of the motors and the decision-making were done by a micro controller called Arduino. By comparing the stopping time of each different variable/algorithm, the most efficient method was found.

Results

It was discovered that the pendulum stopped faster when the motor was spun at the top. It was also found that the relationship between the amount of inertia created by the motor to "cancel" a force and the velocity of the swinging pendulum is linear. From these results, the pendulum's swinging time was reduced to about 1/5 of the free-falling time.

Conclusions/Discussion

My conclusion is that more inertia could be created by spinning the motor when the pendulum is beginning to fall. It was hypothesized that this is probably due to the slow reaction speeds of the current motor, which takes time until the motor reaches that speed. If inertia is created more when there is a greater change in motion, it means more inertia can be created when the motor spins longer: in this case, to be spinning from the beginning. From these collected results, I was able to write the stopping algorithm for the pendulum, ending up shortening the time up to about 1/5 of the free-swinging pendulum's stopping time. This clearly shows the powers of inertia; how much it can affect an object and how it can be freely controlled by the movement of a single motor.

Summary Statement

This project's objective was to figure out how the force of inertia is most efficiently created; how it can be controlled to eventually be used in balancing robots.

Help Received

Father helped weld the attachment part of the pendulum and the motor, along as teaching me programming; Mother helped print binder