

# 3-D Clinostat

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#### **ABSTRACT**

To study the effect of a zero-gravity environment on plant matter, Dr. Richard Barker requires a machine to manipulate the petri dishes in a way that cancels out the effects of gravity on growth. A machine that can accomplish this task is a 3D Clinostat.

## PROBLEM STATEMENT

**Problem**: To create an affordable and accessible 3-D Clinostat, for use by educators and researchers, that can be created with rapid prototyping technology.

**3-D Clinostat Definition**: The usual type of clinostat turns slowly to avoid centrifugal effects. By rotating about both axes, the plant is not permitted to respond to gravity. If the device is too slow, the plant has time to generate physiological responses to gravity; if it is too fast, centrifugal forces and mechanical strains introduce artifacts. The optimal rotational speed has been determined to be between 0.3 and 3 rpm for most plant systems.

## **Design Specifications**

- Determine best method for giving light to plant
- Adequately cancel the gravitational pull on plant growth
- Smooth consistent rotation
- Low cost

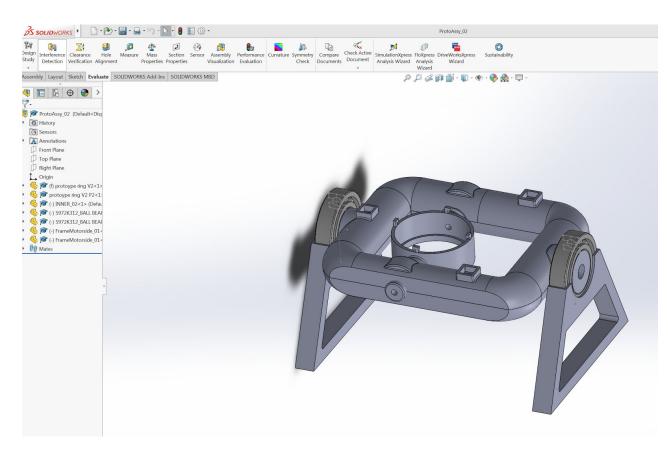
#### MATERIALS

- (2) Arduino's
- (1) Nema 14 Stepper motor and a4988 Stepper Driver
- (1) 28BYJ motor and Driver
- ABS, PLA and Resin prints
- (4) Various Sized Bearings

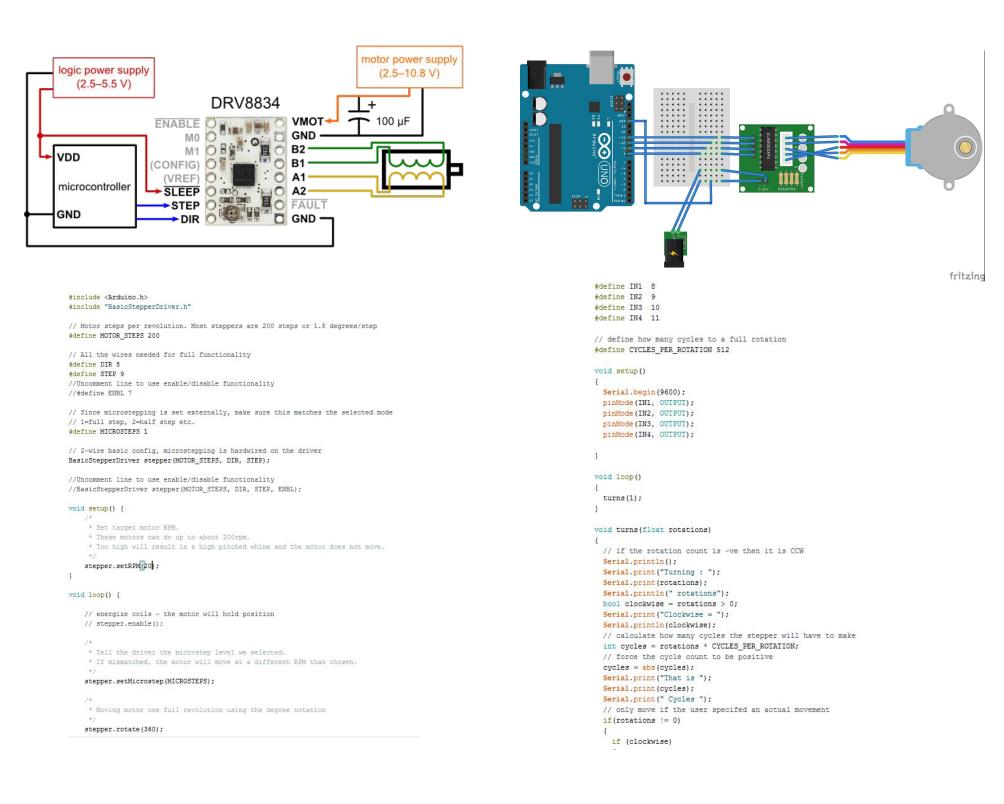
• (1) 12 Wire Slip Ring

## **METHODOLOGY**

• Design frame that simulates antigravity with dual-ring system



Devise a system to drive the rings of the Clinostat



 Utilize a technology for prototyping and creation of 3D clinostat, Additive 3D printing selected.

## Issues and Solutions

- Turning rings
  - -Used separate motors for inner and outer rings
- 3-D Printing Quality
  - -Printed on flats, created holes to allow parts to cool, and learned more about MakerBot software
- Friction
  - Implemented bearings
- Weight
- -Shifted from PVC pipe to lighter-weight materials

## FUTURE IMPROVEMENTS

- Integration of controlled light sources into the frame
- Simple interface to adjust motor rotation speeds
- Shift printing to higher quality printer
- Increasing Smoothness of Rotation



## ACKNOWLEDGEMENTS

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