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DEVELOPMENT OF A LOW COST RANDOM POSITIONING MACHINE DESIGNED FOR THE SIMULATION OF MICROGRAVITY IN LABORATORIES AND BIOLOGICAL RESEARCH.

Abstract

It is currently very easy to find different RPMs (Random Positioning Machine) in the market for a research lab, although, they all require a significant monetary investment (around tens of thousands of dollars per machine). This project aims to develop an Open Source RPM that facilitates a research platform much more accessible to low budget laboratories.

The design and fabrication make use of highly accessible technologies, such as 3D printing and electronic boards based on Arduino properly modified for this purpose.

A critical aspect for this design to be valid for its intended use is the need of a proper calibration of the machine. This means that it needs to be possible to predict analytically the cinematics of the machine and for it to behave in the exact manner that the uploaded program tells it to. It is necessary to consider the torque that the stepper is capable of delivering and adjust the program based on the maximum angular acceleration achievable.

Furthermore, not only will this design be able to simulate microgravity, although it will also be possible to adapt the program for the machine to simulate any gravity below earths. For this purpose, a software capable of controlling the machine will be developed; it will also conduct all the calculations prior to the experiment (such as intended gravity, experimentation time, etc).

Besides, this project intends to study the growth of common plants under this simulated gravity. To do this, we will take seeds of the arabidopsis thaliana plant and other different widely used plants in human diet, like lettuce (Lactuca sativa), tomato (Solanum lycopersicum), carrot (Daucus carota subsp. sativus), potato (Solanum tuberosum) and pea (Pisum sativum). They will be put in an agar medium inside a cubicle, which is in the centre of the RPM. The growth of the seeds will be monitored with cameras, to observe the reaction to the conditions created by microgravity, with the goal of checking the viability of growing terrestrial plants in a different to Earth, such as a space station or a hypothetical space travel.

We also pretend to eliminate the need of a space station to conduct research in biological studies under microgravity. This will allow a further experimentation in this area of study, at a lower cost compared to the currently available options.