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DESIGN OF NUTRIENT GEL-BASED HYDROPONICS SYSTEM FOR PLANT GROWTH EVALUATION IN A 1.5 U CUBESAT

Abstract

The research aims at proposing an experiment setup to observe plant growth in microgravity constrained environment. In this context, a 1.5 U CubeSat is modelled to suffice operating conditions of low earth orbit and mission life of 4 weeks. The proposed payload comprises of plant chamber with circular tube contented with major plant growth elements and identical, but equally spaced plant placement bubbles facilitated with necessary air volume and moisture regulation to support a fast-growing plant from seed to seed. Addressing the constraints of 1.5U CubeSat, a fusion of hydroponics and a nutrient gel is chosen as the method for plant growth. The nutrients required for plant growth will be made in the form of a nutrient gel that will surround the growing seed. An array of light emitting diodes (LEDs) emitting light wavelengths that match the properties of chlorophyll is used to artificially simulate plant growth, and the same is monitored by a suite of sensors: temperature, pressure, relative humidity, CO2, pH indicator, and imaging. The latter takes periodic still pictures in the infrared spectrum using LED based illumination at different wavelengths. Images from Cameras would be transmitted and used to analyse the overall health of the plant and record the developmental stages of the plant growth. The payload platform is complemented with a microcontroller and a solar panel-based power generation system along with a provided battery. The former can be a source of nutrients for plants and decrease induced stress on these in space conditions providing psychological support. The availability of test chambers allows scientists to quantify changes and investigate emergent properties of the growing saplings. The CubeSat design presented in this paper, offers the opportunity to investigate the impact of physical factors i.e., pressure, temperature, microgravity on plant advancements. This platform can be adapted and expanded for further similar scientific research. Our experiment aims at testing technologies for plant cultivation in a minimalistic space station environment.