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LUNAR GREENHOUSE CULTIVATION ACTIVITIES THROUGH VIRTUAL REALITY SIMULATION: V-GELM PROJECT

Abstract

In the near future the Artemis mission will start the development and build of the first lunar space station, the Lunar Gateway: an orbital platform that will be used to extend the human presence beyond the borders of the Earth. To sustain life for long mission, the autonomous production of nutrients and oxygen is of mandatory importance. Recycling resources permits to reduce the lunar station operative costs, reducing the mass of the supply rockets. Greenhouses can partially solve the issue contributing with the usage of plants to the production of fresh edible food, clean water and oxygen. Moreover, if supported by bioreactors, plants can be used in a closed recycling loop to recover some of the waste produced from the astronauts. To reduce encumbrance, it is possible to develop inflatable greenhouse module. Moreover, to aid the project and test VR (Virtual Reality) tools can be used. VR permits to have a first-person interactive perspective useful to study the ergonomics and operations. The feedback from these analyses is important not only to train astronauts but also to improve the module itself, identifying issues and risks that might otherwise be overlooked. Virtualization brings to a reduction of costs, allowing to test module performances before construction. The proposed greenhouse module has been called "V-GELM" (Virtual Greenhouse Experimental Lunar Module) and it can accommodate up to five cultivation units "HORT3". These units have been developed for the AMADEE-18 Hortextreme mission, to simulate a Martian greenhouse in the Oman desert, and consist in a highly efficient hydroponic system developed for microgreens growing. Every unit can grow up to 3-6 kg of edible food every 15 days, 200 to 400 g/day of fresh microgreens depending on the selected species, enough to cover the daily nutritional needs of 2-4

astronauts. The greenhouse module is shielded from radiations by a 3D-printed ice cover and powered by a grid of solar panels. The structure is designed to be built with aluminum frames and secured on ground by pickets. It this work the module structure the requirements and the simulation procedures which will be used for in the VR environment will be discussed. In the Interactive Presentation, videos from the VR interactions, operations and a detailed description of the produced models will be presented. The project is supported by the IG-Luna initiative from ESA-Lab and the Swiss Space Center.