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Generic Technologies for Nano/Pico Platforms (6B)

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AUTONOMOUS CULTIVATION SYSTEM FOR NANO PLATFORMS: THE GREENCUBE MISSION

**Abstract**

Nowadays, the growing interest in long-term space exploration missions targeting permanent bases on Moon and Mars requires the development of technologies for in autonomous production of nutrients, food and resources to support human life in outer space. In this framework, "ready to fly" experiments

hostable in small satellite platforms can greatly support the ongoing research on the optimization of human nutrition and space cultivation. The GreenCube mission is a 3U CubeSat project developed by the S5Lab (Sapienza Space Systems and Space Surveillance Laboratory) research group, together with ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) and University of Naples Federico II (Department of Agricultural Sciences). The project is coordinated by the Italian Space Agency (ASI). The mission is aimed at demonstrating the functionalities of an autonomous miniaturized cultivation system on-board a CubeSat platform. Two units of the CubeSat (200x100x100 mm) will be dedicated to the cultivation of microgreens. In this cultivation unit, a variety of low-cost technologies will assure pressurization and air pressure monitoring, air composition sensing, temperature monitoring and control, water and nourishment management, circadian cycles reproduction and cultivar monitoring through optical sensors. The majority of these components are based on Commercial-Off-The-Shelf (COTS) units that have been prototyped and qualified for space. The mission has been developed and qualified for spaceflight between 2020 and 2022 and it will be launched with the maiden Vega-C flight in mid-2022. More than 10 growth experiments has been performed during the functional tests in order to assure the well-functioning of the payload unit. If successful, the demonstration conducted by GreenCube will suggest a further implementation of the same cultivation unit design for further in-orbit experiments. This paper will deal with the GreenCube satellite design and qualification, as well as with the implemented technologies on-board the CubeSat. After an introductory section related to the mission, the payload, bus and interfaces design will be described, an overview on the functional and environmental tests will be provided and future perspectives for the developed units will be presented.