DESIGN AND OPERATIONS OF ENVIRONMENTAL ANALOGS IN LUNARES HABITAT.

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Introduction: Establishing habitat Lunares was one of the fastest realization of this kind in the world (**Fig. 1-3**). It was created by private space enthusiasts, who sponsored the design, materials, equipment and building of the facility as well as organization of scientific and exploratory missions. Lunares name derives from LUNA (Moon), and ARES (Mars), to highlight ability to run two types of environmental analogs: lunar and martian ones.

Design: we created 150 square meters of Moon analog basalt regolith surface and 150 square meters of red martian-like rocky surface. This unique terrain is used for extravehicular activities closed in isolated from external environment hangar, where we can fully control lighting modes [1], communication, navigation and environmental conditions such temperature and humidity.

Fig. 1. Timeline of the Lunares Project. Actually 5 analog simulations were performed with success in the facility, 6 new analog missions are planned for 2018. More info about recruitment procedures at our webside (please, see Additional information).

Operations: we developed two different habitat manuals and procedure types, specified for lunar and martian conditions. Schedules and communication modes are running on two different timing systems: Lunar Standard Time (LST) for lunar missions [2], and Mars24 Sunclock [3] for martian analogs. Max. 6-8 analog astronauts can live together during single mission. Analog simulations can be fully autonomous controlled by astronauts crew, or controlled fully remotely from the Mission Control Center located anywhere, from where access to internet exists.

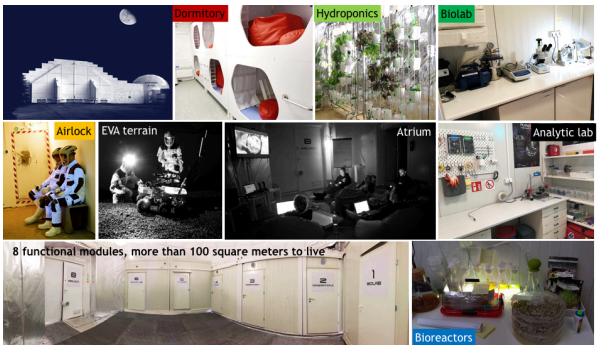

Fig. 2. The habitat has 8 functional modules connected with social area called Atrium (108 square meters): Dormitory with 6 private chambers, Biolab with hydroponics and bioreactors, Analytic lab, Kitchen, Operations room, Storage and Sanitary Modules, finally Airlock module connected to isolated EVA terrain (photos: Space Garden, Mariusz Słonina).

Fig. 3. ExoGeoLab from ILEWG equipped with VIS/IR spectrometer and telescope ready for use during EVA operations (**up**). Telerobotic operations using Modernity Rover (**down**).

The unique feature of this facility is independent operational system (with martian and lunar modes of architecture) designed and written by Matt Harasymczuk (**Fig. 4**). Additionally, together with our collaborators, we are developing VR technologies such as Soyuz or ISS simulators, telerobotic operations and cognitive analog astronaut training softwares for example: subjective time perception training [4]. VR technology will be particularly used for EVAs, where lunar or martian surfaces will be displayed on already existing membranes covering the hangar.

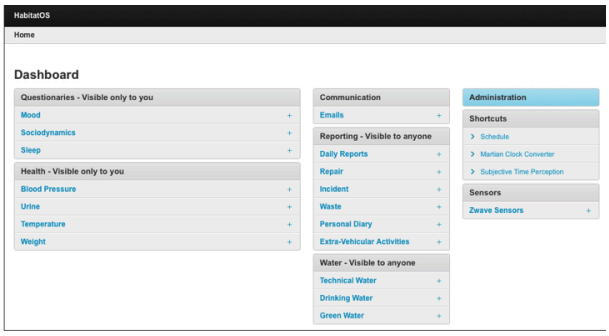

Fig. 4. The dashboard of the HabitatOS with multiple functions including control and monitoring of the habitat modules and operations during analog missions. Habitat monitoring was set using ZWave sensors by Matt Kraiński and Matt Harasymczuk (**Fig. 5**).

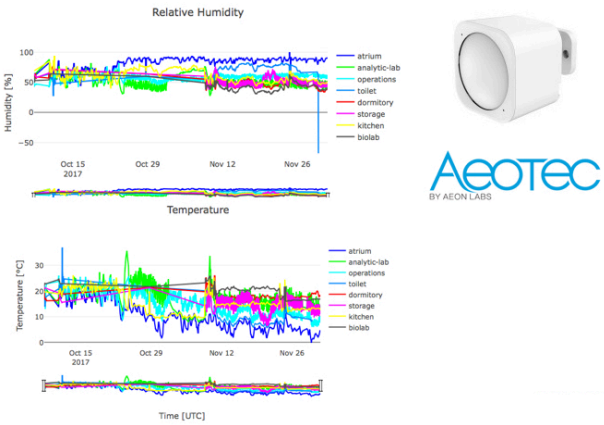

Fig. 5. Each module of the habitat Lunares has its own monitoring system for environmental parameters such as: illuminance, radiation, temperature, humidity, pressure, etc. Data are continuously recorded, stored and visualized on charts in HabitatOS.

References: [1] Kolodziejczyk A. M., Orzechowski L. and Lakk H., Acta Futura 10 (2017), ISSN 2309-1940. [2] www.lunarclock.org, [3] https://www.giss.nasa.gov/tools/mars24/, [4] Kolodziejczyk A. M., Harasymczuk M. et al. (2017) Circadian Clock and Subjective Time PErception: A Simple Open Source Application for the Analysis of Induced Time Perception in Humans, *Conference Proceedings*, Prague Czech Republic Mar 23-24, 19(3) Part VIV p. 1664-1668.

Additional Information: www.lunares.space, www.space.garden, www.astrotech.io/subjective-timeperception, Modernity Rover Team: www.facebook.com/pczroverteam/

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