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THE SMART MODULAR HABITATION SYSTEM FOR MEDICAL SUPPORT AND ASTRONAUT SAFETY DURING LUNAR EXTRAVEHICULAR ACTIVITIES (EVA)

Abstract

The anticipated increase in crewed missions to the Lunar South Pole, along with the corresponding in-situ resource utilization (ISRU) activities, underscores the critical need for comprehensive medical support systems in extreme environments. This paper unveils the design of an innovative Smart Modular Habitation (SMH) system, aimed at enhancing Human lunar expeditions and initial ISRU efforts. Central to this initiative is the development of a medical module designed to proactively manage health risks associated with extravehicular activities on the Moon.

Our approach begins with a detailed literature review to identify crucial tasks and potential injuries during lunar EVAs. This includes examining the International Space Exploration Coordination Group's (ISECG) Global Exploration Roadmap, historical Apollo mission data, and injury profiles from harsh terrestrial environments, such as polar regions, high altitudes, and mining sites. In the next step, this comprehensive analysis informs the development of effective countermeasures. Subsequently, an analysis of these countermeasures guides the design trade-offs, leading to a detailed definition of system requirements and an architectural blueprint for the medical support module, ensuring readiness for a wide range of lunar mission contingencies. Fourth, the study presents an innovative internal layout design featuring adaptable shelving systems with mobile platforms, tailored to various needs. Lastly, this paper outlines a roadmap and practical implementation plan for rigorous terrestrial trials of the SMH system in Antarctica. Additionally, the potential for dual-use applications of the SMH, such as for disaster relief on Earth, is discussed.

The research on the SMH system will contribute to the longevity and success of future lunar missions by ensuring essential medical support and power supply services.