Paper ID: 49721
oral

17th IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE (D4)
Innovative Concepts and Technologies (1)

Author: Ms. Tamalee Basu
University of Houston, United States

Prof. Olga Bannova
University of Houston, United States
Dr. Jorge D. Camba
Purdue University, United States

MIXED REALITY ARCHITECTURE IN SPACE HABITATS

Abstract

Mixed Reality (MR) technologies are rapidly establishing themselves in the space industry. From assisting with assembling the Orion capsule through Augmented Reality (AR) to using highly immersive virtual environments for astronaut training, MR technologies provide a powerful mechanism to alter the perception of the physical world and deliver realistic personalized visual stimuli to users.

In this paper, we discuss a strategy to utilize MR technologies as a design element to enhance the interior architecture of the space habitat and enrich the inhabitants' personal experience. Two scenarios are discussed: a prolonged stay in a deep space transit vehicle in a Mars mission, and a customized experience for space tourists in LEO. A series of spacecraft volumetric studies of the ergonomics associated with the application of MR technologies are reported. Physical, Virtual and Overlapped experiences are mapped within the volumes with respect to crew ConOps. The experiences are then analyzed and translated to architectural design requirements that inform criteria for the development of personalized MR-based visualizations.

For the first scenario, NASA's 500 days on the surface of Mars mission is considered, which requires 600 additional days in microgravity transit inside the Deep Space Transfer vehicle, a 7.2 m wide hard-shell module. In this scenario, MR experiences are used as a stress countermeasure to help a crew of four sustain psychological and behavioral health, maintain productivity, and stimulate teamwork and performance. This is accomplished by providing novelty in the habitat as well as designing content that can increase the volumetric perception of the environment.

The second scenario is presented in the framework of space tourism where habitats with minimum physical interior design elements can be transformed into comfortable personal environments. Bigelow Space Operations' B330 was selected as a reference site for a 12 day LEO tourism mission. We discuss a design approach that provides tourists with a high level of comfort by using projection-based MR technologies to customize personal spaces based on individual user preferences. The implementation of these elements can help minimize launch requirements and significantly reduce time and cost (both in terms of development and maintenance).

The paper concludes with a discussion of directions for future research and design-based investigations. Compilations of mission-influencing factors such as launch mass and volume reduction per habitat, technology limitations and integration requirements are presented and evaluated by the level of importance for achieving mission goals and objectives.