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Challenges of Life Support/Medical Support for Human Missions (8)
Challenges of Life Support/Medical Support for Human Missions (2) (2)

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INTERPERSONAL INTERACTION DESIGN FOR LONG-DURATION EXTRA VEHICULAR ACTIVITIES

Abstract

Extra vehicular activities (EVA) play a crucial role in current and future space exploration missions. Specially designed spacesuits provide astronauts with the protection and functionality to perform tasks outside of the spacecraft but can also simultaneously impair the astronauts' ability to communicate and collaborate effectively. Future long-duration exploration missions (LDEM) will require astronauts to interact cohesively while under extreme levels of stress for long periods of time, making crew collaboration even more vital to successfully meet mission objectives. This project examines crew interaction during EVA and evaluates technologies that could enhance nonverbal communication between astronauts. Nonverbal communication is a significant element of interpersonal interaction and team cohesiveness. People interpret emotions by analyzing subtle facial expressions and physical gestures. These 'basic' forms of nonverbal communication are often not available to astronauts during EVA. A qualitative, human-centered design research was conducted, combining theoretical data with interviews of astronauts and industry specialists. This methodology led to insights that focus on the astronaut's experience while interacting with fellow crewmembers and with ground control. Based on the research findings, factors affecting crew communication during EVA were analyzed, including: 1. Low situational awareness and dexterity; 2. Lack of privacy as a result of a single channel of communication; and 3. Limited ability to recognize facial expressions. Artificially displaying facial expressions and gestures during EVA was identified as a key concept, capable of enhancing crew coordination in close proximities, as well as providing an additional channel of communication. The feasibility of projecting a synthetic facial model (avatar) on the astronaut's visor in real-time, was evaluated. Such technology is currently in development for VR and AR applications, where high-resolution graphics and advanced motion tracking provide a virtual, yet 'natural' interaction experience based on synthetic imagery. Challenges regarding the integration with helmet designs were addressed, considering the field of view (FOV) obstructions, display technologies, and other technical constraints. In addition to proposing a practical solution, this project offers an opportunity to re-imagine the way astronauts interact, by breaking existing communication paradigms.