Space Stations & Challenges (12)
Space Stations & Challenges - Session 1 (1)

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SPACESUIT AUGMENTATION FOR CAPACITIVE TOUCH DISPLAY INTERACTION: ENHANCING HUMAN-COMPUTER INTERFACE FOR SPACE MISSIONS

Abstract

As human space programs continue to advance, the need for effective human-computer interaction has become increasingly critical. This paper investigates a novel approach to augment the existing spacesuit to enable its operability with a capacitive touch display, enhancing a crew's ability to effectively interact with the touch display. A capacitive touch display offers enhanced user interaction through multi-touch capabilities, surpassing resistive displays in user-friendliness. A capacitive touch display operates by detecting changes in its capacitance when a conductive object comes in the vicinity of the screen. However, the current design of the spacesuit lacks this interaction due to the absence of conductive material near a glove's fingertip, necessitating innovative modifications to use it in the human space program of ISRO. We propose a novel augmentation method that incorporates flexible conductive material, allowing for seamless interaction with capacitive displays while maintaining the protective integrity of the suit. Our approach includes an analysis of material properties, ergonomic design considerations, and functional testing in simulated environments. We evaluated both conventional and non-conventional conductive materials based on preliminary functional testing to determine their effectiveness in accurately registering touch inputs. Additionally, the shape of the selected material was optimized to conform to the glove's fingertip, ensuring seamless interaction with the display. A specialized rubber cap was designed and developed to securely integrate the conductive material with the glove's fingertip. The selected materials were taken through space and human rating qualification tests. Through rigorous functional testing of the actual augmented spacesuit glove, it was demonstrated that crews can efficiently operate capacitive touch displays while wearing their gloves. The results indicate that this enhancement not only improves the functionality of the spacesuit but also paves the way for more intuitive interfaces in future human space missions. This research contributes to the ongoing development of user interface technologies for space stations, with a focus on material selection and design optimization to ensure both functionality and safety.

Keywords: Human-computer interaction, Spacesuit design, User interface optimization, Spacesuit innovation, Spacesuit glove modification, Space technology development, Space station interfaces, Spacesuit augmentation