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USING EXTENDED REALITY AS A DESIGN AND TRAINING TOOL FOR A FUTURE LUNAR HUMAN HABITAT: THE FLEX-XR CASE STUDY

Abstract

Innovative technologies for human-machine interaction, such as Virtual Reality (VR) and Augmented Reality (AR) are opening up a wide range of application opportunities, including astronaut and ground segment personnel training. In view of the National Aeronautics Space Administration (NASA) Artemis program, whose aim is to land astronauts on the Moon by 2024, the European Space Agency (ESA) together with the German Aerospace Centre (DLR) are preparing for future missions to the lunar surface. They are working together for the implementation of the LUNA analogue facility, that incorporates different capabilities, to be built in Cologne, Germany. One of them is the habitation module known as Future Lunar EXploration Habitat (FLEXHab), which is being developed at ESA's European Astronaut Centre (EAC). It will provide the possibility to perform integrated surface operations simulating a human presence on the Moon. FLEXHab will allow a crew of 4 astronauts to simulate several activities including scientific experiments. Moreover, it will offer the opportunity to test and evaluate novel interactive and collaborative training technologies for astronauts in a realistic operational scenario. In this context, the FLEXHab eXtended Reality (FLEX-XR) project is currently under development as a collaboration between ESA, DLR and the Netherlands Aerospace Centre (NLR). It aims at advancing the state-of-the-art of interactive and collaborative training technology by developing and evaluating a new astronaut

training framework using AR and VR tools. In fact, new training methods need to be developed to support future human deep space exploration endeavours. Actually, AR/VR technologies present great potential in making training more efficient and effective, as already demonstrated by past research initiatives. Phase 1 of the project foresees the implementation of an interactive VR digital twin of FLEXHab, including all its relevant systems such as data management and communication, environmental control and life support and power supply. Besides training, the VR digital twin allows users to familiarise with FLEXHab, define and test potential user interfaces and perform ergonomics assessments. For the VR digital twin, 3D models have been created and integrated in the virtual environment, interactive elements and training material have been designed. Additionally, realistic concepts of operation for different training scenarios have been generated for the technology assessments. During phase 2, an interactive AR digital twin will be developed to enhance collaboration between users. This work describes the design and development of the VR digital twin, conceived training scenarios and results of initial qualitative user assessments.