Augmented Reality based Rover Maintenance in Mars/Moon Terrain Demonstrator

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1. Introduction

This industrial paper introduces the work done within the WEKIT - Wearable Experience for Knowledge Intensive Training – project. WEKIT is a three years project funded by the European Commission under the H2020 programme. It aims at creating an AR-based technological platform and an industry-focused learning methodology, then to widely share its methods and research findings and make them part of a repertoire of Europe's communities in Technology- Enhanced Learning (e.g. content developers, trainers) and end-users (e.g. in Industries). WEKIT exploits Augmented training in situ with live expert guidance capturing tacit learning experience with Wearable Technology (WT) and re-enactment of the expert with Augmented Reality (AR). The project is supported by three Industrial Cases: (1) Aircraft maintenance: exploiting AR and WT for inspection, decision making and safety; (2) Healthcare: exploiting AR and WT for improving innovation in technology and responsibility in healthcare applications and medical imaging; (3) Space: exploiting AR for astronauts training and for supporting the Mars rover maintenance. In this paper, we will focus on the second evaluation cycle of space Industrial case.

2. Evaluation case of the WEKIT AR-player

Working in the space domain means working in a complex and challenging domain, dealing with huge amount of datasets and several actors (engineers, scientists, discipline experts, etc.). To fully exploit people's know-how and all the available data, it is necessary to find a way to ease the communication and collaboration among the actors involved and at the same time to support the knowledge transfer. The scenario identified for the WEKIT space case is to check the status of the rover (damages, functionalities, etc.) and charge the battery. Also, during the execution of the procedure, unexpected errors triggered by sensor data shall be handled.
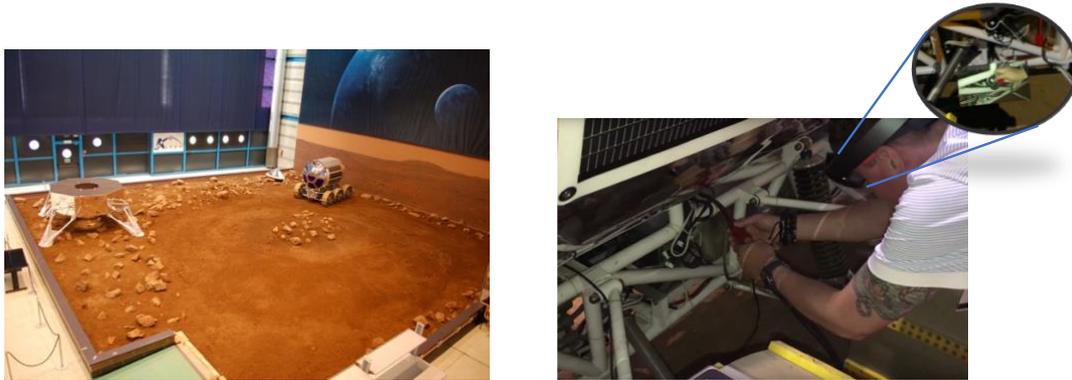
Figure 1. Left: Mars rover in Mars/Moon terrain simulator. Left: Video in 3D space for task support

The second iteration of the WEKIT AR-player (Helin, 2017) the trial and evaluation phase will be ended by October 2018. The WEKIT space case was tested at ALTEC facility (Turin, Italy) performing a futuristic astronaut procedure on a physical mock-up of Mars Rover in Mars/Moon Terrain Demonstrator. More than 100 subjects were testing the system during 3 months period. Data and feedback from the participants were collected by means of a questionnaire composed by several sections (Learning Model, Technology Acceptance Model, the Spatial User Interface of AR, and System Usability Scale) and some additional questions that were asked to a smaller subgroup of the participants in order to get a more comprehensive feedback on their experience.

3. Evaluation results

During the first trial campaign held on May 2017, the WEKIT AR-players usability had reached a reasonable level (average System Usability Scale - SUS score 68), both the pragmatic and emotional aspects of the user experience were considered fulfilling. It can be suggested that the AR-system is potentially a useful tool for supporting and facilitating the assembly and training procedure in the space field, even though the tool is still in prototyping phase (Vizzi et al., 2017). Preliminary results from the second trials shows that usability of system has been increased as AR-player has updated based on feedback from the first trials such as card user interface, orange guiding lines in 3D space, and all functions are working with gestures, voice commands and via button. Detailed results will be shown in the conference presentation.

Acknowledgements

References

Helin, K.: Augmented reality for AIT, AIV and operations. Space Engineering and Technology Final Presentation Days, SET-FPDs, Abstract book, pp. 20-20. ESA/ESTEC, The Netherlands: ESA (2017).

Vizzi, C., Helin, K. & Karjalainen, J. (2017). Exploitation of Augmented Reality for astronaut training. In EuroVR conference 2017. EuroVR Association.

Appendix

Video from the second trials   https://youtu.be/JRMLs9SYg6k