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ARSIS 2.0: Augmented Reality Space Informatics System

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Abstract

Augmented reality (AR) can improve efficiency and add a level of safety to extravehicular activity (EVA) procedures in outer space. During these EVA missions, it is important to be able to communicate complex data and instructions to crew members in an effective and reliable manner. Currently, crew members use only voice communication with Mission Control and intravehicular crew members to gain feedback and instruction. Additionally, crew members follow paper instructions secured to their wrists for procedure direction. While this method has historically been reliable, AR can improve this process by increasing crew member autonomy, facilitating enhanced communication and collaboration with Mission Control, and by making instructions more dynamic, reliable, and unobtrusive.

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Authors

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ARSIS 2.0

Augmented Reality Space Informatics System

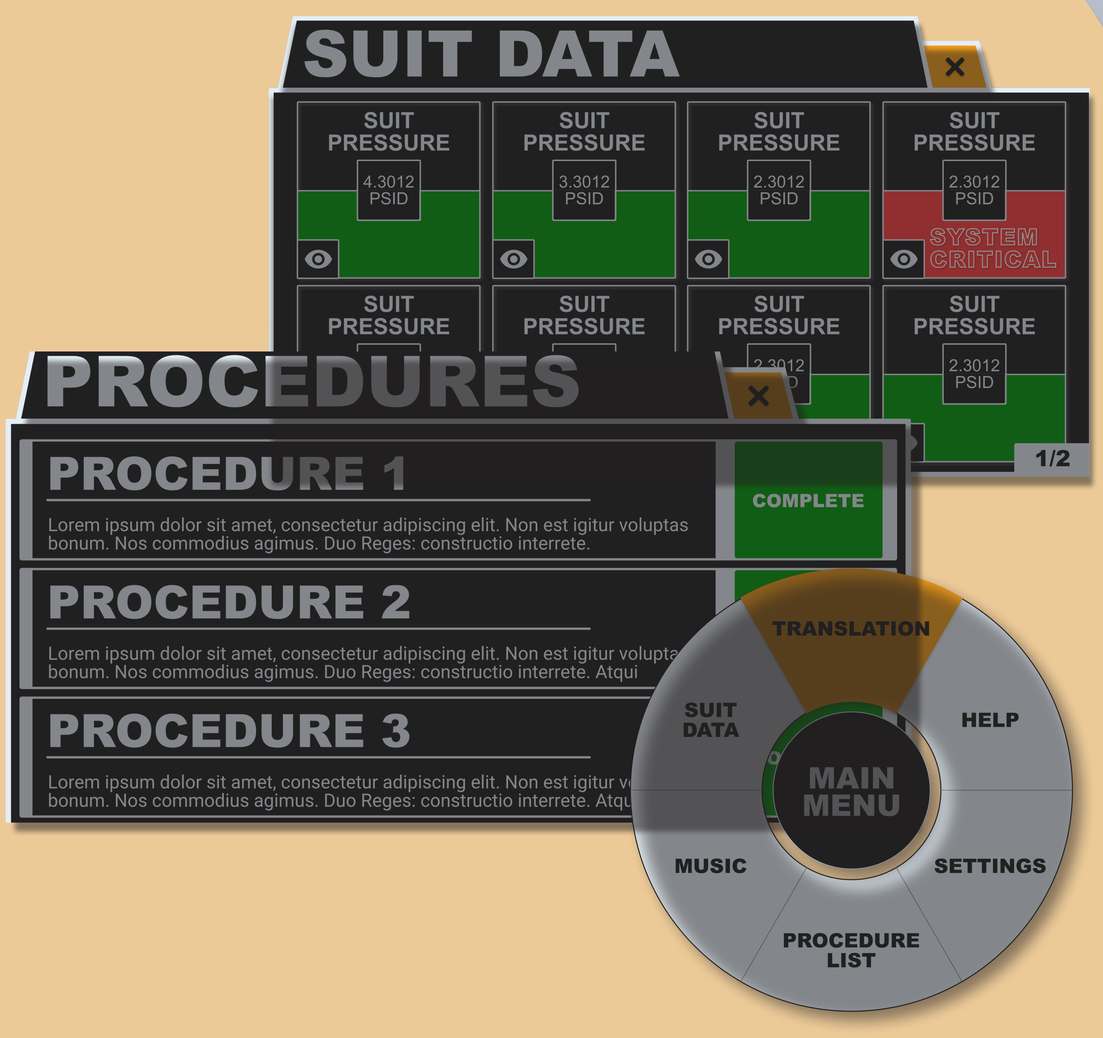
Team Management:

Liz Altmiller (Team Lead), Taylor Campbell, Tyler Chapman, Dean Cohen, John Garrison, Graham Hill, Daniel Lambert, Brenna Leonard, Katelyn Schuettke, Marie Shirley, Olivia Thomas, AJ Trantham
Advisors: Steve Swanson, Dr. Karen Doty

Introduction

The Augmented Reality Space Informatics System (ARSIS 2.0) is an Augmented Reality (AR) user interface (UI) system built for Microsoft HoloLens by the Boise State University NASA SUITS (Space Suite Interface Technology for Students) to assist NASA astronauts in extravehicular activity (EVA) missions outside the International Space Station (ISS), and possibly the Orion Gateway, and beyond. ARSIS can improve safety and reliability by increasing crew member autonomy and making task instructions more dynamic, reliable, and unobtrusive. Features include anchored procedure instructions, visual communication with Mission Control, navigational assistance, virtual reality (VR) environment transmission to a ground station, eye tracking, and voice commands. “ADELE,” which stands for Audio Device for Extra-Terrestrial Listening Environments, is ARSIS’ voice command system, an homage to Adele Goldstein, one of the original ENIAC programmers.

ARSIS Interface



Abstract

AR can improve efficiency and add a level of safety to extravehicular activity (EVA) procedures in outer space. During these EVA missions, it is important to be able to communicate complex data and instructions to crew members in an effective and reliable manner. Currently, crew members use only radio voice communication with Mission Control and intravehicular crew members to gain feedback and instruction. Additionally, crew members follow paper instructions secured to their wrists for procedure direction. While this method has historically been reliable, AR can improve this process by increasing crew member autonomy, facilitating enhanced communication and collaboration with Mission Control, and by making instructions more dynamic, reliable, and unobtrusive.

With these potential improvements in mind, we designed ARSIS to assist crew members in EVA missions. Aside from the obvious application in space, a similar concepts could be applied to a wide variety of training and instructional applications. In addition to presenting static information in physical space, ARSIS opens the possibility for users to collaborate with long-distance teachers or experts in a more personal and visual way.

Moderated usability testing and user surveys show that 100% of users preffer the ARSIS HoloLens App over other mediums of assistance and communication, including AR tablets and paper instrucions. Users also found the interface to be aesthetically pleasing, easy to see and understand, and relatively simple to use.

Methods

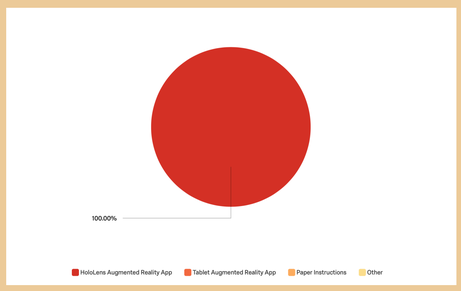
ARSIS was created using C# in Unity, for the Microsoft HoloLens. This foundation program has two sister components which communicate via networks. They allow ARSIS to connect to both a VR environment in Unity using Oculus for 3D visualization of the primary user’s environment, and a web based desktop interface for a secondary user to upload procedures and content to the primary user, on the fly.

We hypothesized that users would prefer ARSIS in the Microsoft HoloLens over mediums such as AR on a tablet, or paper instructions.

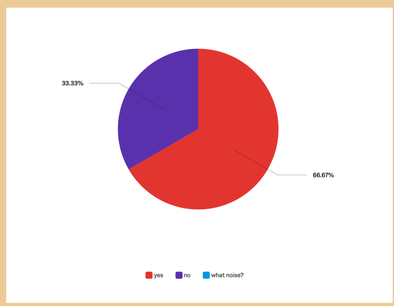
We further hypothesized that users would benefit from visual aids that could be offered more easily on an AR display than on more traditional mediums, such as paper instructions.

Testing for ARSIS includes a combination of moderated user testing, as well as user surveys completed after the testing session was finished. Test subjects, whose ages ranged between 12 and 99, were 50% male, 43% female, and 7% other genders.

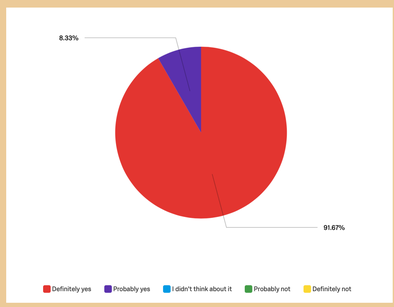
Results



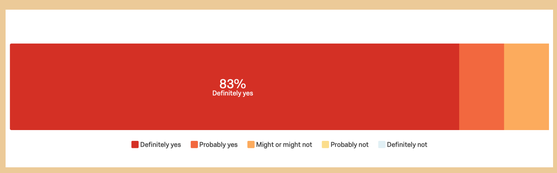
Preference of ARSIS HoloLens application or other mediums of interaction



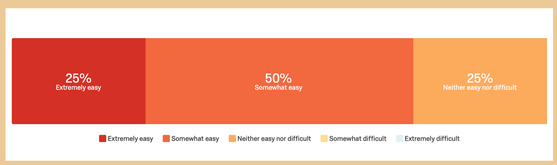
Users reported dificulty using voice commands in a noisy environment



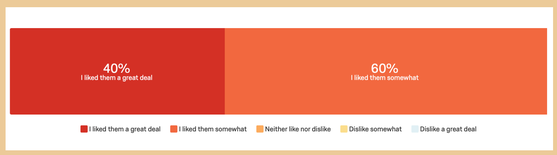
Aesthetic appeal of ARSIS Interface



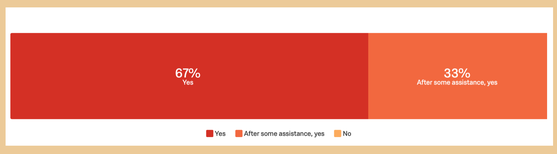
Usefulness of ARSIS visual aids



Ease of Use: ARSIS Interface



Likeability of Sound Effects among the 83.3% of users who noticed them



Ease of Use: Navigational Assistant

Conclusions

100% of ARSIS users preffered it to other mediums for the same task. 83% of users reported definitely bennefiting from visual aids within ARSIS. Over 90% of users thought the interface was aesthetically pleasing, and 75% of users reported ease in using the application.

Acknowledgements

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