Eyewear User Interface for Marsonauts

The main purpose of the project is to test the adding value of virtual reality glasses in the context of space exploration and extravehicular activities. This experiment will use in particular the AR Glasses of the French company *Optinvent* with which we are in contact. A first test phase should be conducted by Crew 151 (International Emerging Space Leaders).

This tool already includes many applications such as taking pictures, and a MDRS simulation would be a great opportunity to add some features and functions which would be helpful for extravehicular activities. Indeed, an efficient human-machine interface could allow us to save precious time while being more efficient.

For this rotation, we would like to improve the IVS aspect of the AR glasses. In particular, among the functions that could be added and tested:

- Improving the vocal commands we already coded by adding new features such as note taking, procedure steps display ;
- Taking pictures and videos through the helmet ;
- Displaying some procedures on the screen ;
- Communicating with the hab ;

We feel like mentioning that these are only some of the ideas we have but we are waiting for the results and feedback from Crew 151 in order to be able to focus on the problems that need to be taken care of before announcing too ambitious schemes.

Relevance to Mars

After discussion with former MDRS crews, it appeared to us there could be more difficulties than we thought to achieve simple tasks such as taking pictures because of the gloves and helmet of the spacesuit.

Smart glasses could help fix these problems and help the astronaut to take pictures of the landscape and rock samples more easily without even having to use their hand. In addition to taking pictures, the smart glasses could actually be used to get easily access to the information that the astronaut needs. There are actually a lot of possible information we can put on the "screen" of the glasses to help the astronaut during an EVA : maps, duration of EVA, direction, and so on.

Such a technology could for example replace the unhandy checklist notebook of the Apollo missions. Thanks to this, a lot of data could be automatically transferred to the crewmembers on EVA and therefore dramatically reduce the workload of the backup member who would have to stay at the hab.

We think it could be a very useful tool providing additional situation awareness for crewmembers on EVA and also facilitate the task of the IVS that need to send data to them.

Relevance to MDRS simulation

NASA tested out the Google Glass for the first time during NEEMO 17 (or 18) simulation. A brief NASA report is available on the Internet explaining the experiments they conducted and the conclusions that were drawn in the end. Here is the conclusion of NASA experiment: “Google Glass is a promising technology, but needs to overcome battery life, display viewing and scrolling issues in order to be an operational useful tool.”

Such a project is also undoubtedly relevant to MDRS insofar as it could provide a simplification of the tasks of the astronaut via a hand-free mobility. And this, even if the current material is not adapted yet : small text, video and photos limiting amount of information that can be viewed ; eye strain caused by extended periods of looking up and to the right ; scrolling issues (amount and ease of scrolling) ; short battery life,...

But needless to say that these imperfections are also what make such an experiment perfectly designed for MDRS. It is the perfect place to test solutions to go through the current issues: adapting the way the information is displayed so that it is easily understandable, while optimizing memory and battery life. Concerning eye strain, it is necessary to make “on the ground experiments” in the real conditions marsonauts could encounter: impossibility of rubbing their eyes, brightness or obscurity, long EVAs...

In a nutshell, the main purpose of such a project is to give a clear picture of the way virtual reality glasses can be used, and then to see if the advantages could outweigh the disadvantages. To do so, we think that the experiment could be spread over multiples rotation with improvements implemented each time.

Description of procedure/protocol in detail

- Check and possibly improve the experiments conducted in March 2015 by Crew 151 ;
- Check the interest and capabilities of taking picture and video through the helmet. We could test the possibility of sending those pictures back to the hab by a voice command.
- Evaluate the benefits of displaying urgency or experiment procedures steps on the screen.The different steps of the procedure to perform will appear by saying "next" and "previous".We could then compare the timing and efficiency of two crewmembers, one wearing theAR display and the other performing steps from memory;
- We could use the glasses as a dictating machine to facilitate notes taking during EVA;
- Lastly, the glasses could be used to provide additional situation awareness. For example,one could ask the glasses to see the time or the remaining minutes for the EVA. We couldalso use a database of landscape pictures or topographical maps that one could visualizeand use in order to find one's way back to the hab and to avoid getting lost or hurt.
- Sending and receiving photos to and from the hab in order to assist the crewmembers onEVA ;
- Possibility to replay com messages ;
- Markers saying when Earth should have received the last message and when we can expectan answer.