

Beyond Gravity: Exploring the Use of Augmented Reality Devices for Enhanced Astronaut Performance



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Overview

The space industry and others are continuously integrating Extended Reality (XR) technology more into their domains as it becomes more accessible and advanced (Wirth et al., 2012). This technology currently benefits astronauts as they can use it for conferences, training, maintenance, and other tasks (Stone, 2023). As this continues to develop, it is important to identify potential devices that can improve astronaut performance and complement their everyday tasks.

Current Study:

- Comparative analysis of XReal Air 2 Pro Glasses, Meta Quest 3, and smart tablet for astronaut tasks
- Usability tests tailored to astronaut performance evaluated interaction and perception of XReal Air 2 Pro glasses versus Meta Quest 3 and a smart tablet
- Evaluation focused on user preference, comfort, and text clarity, particularly during spacewalk video and schematic viewing

Method

Participants

- 10 undergraduate/graduate Embry-Riddle Human Factors Psychology students

Post-Study Measures

- Eye Fatigue Questionnaire
- System Usability Scale
- User Experience Questionnaire - Short

Procedure

1. Participants rotated through the three devices (XReal Air 2 Pro Glasses, Meta Quest 3, and a tablet) in a counterbalanced order
2. For each device, participants first watched a 1-minute spacewalk video to assess video quality
3. Participants then viewed three different schematics of the ISS layout to assess text quality (Figure 1)
4. Researchers asked the participant to identify three areas within the schematics, measuring accuracy and response time.
5. Following the two tasks, the participant was asked to respond to 6 questions that focused on comfort, image and video quality, followed by the post-study measures for the device used.

Takeaways

- Most participants prefer using the tablet because of familiarity or the Meta Quest 3 due to its novelty and greater immersion
- Participants did not select the XReal Air 2 Pro Glasses for streaming videos or enlarging images because of technical issues with the controller and eye strain
- For astronaut training, most participants would use the Meta Quest 3

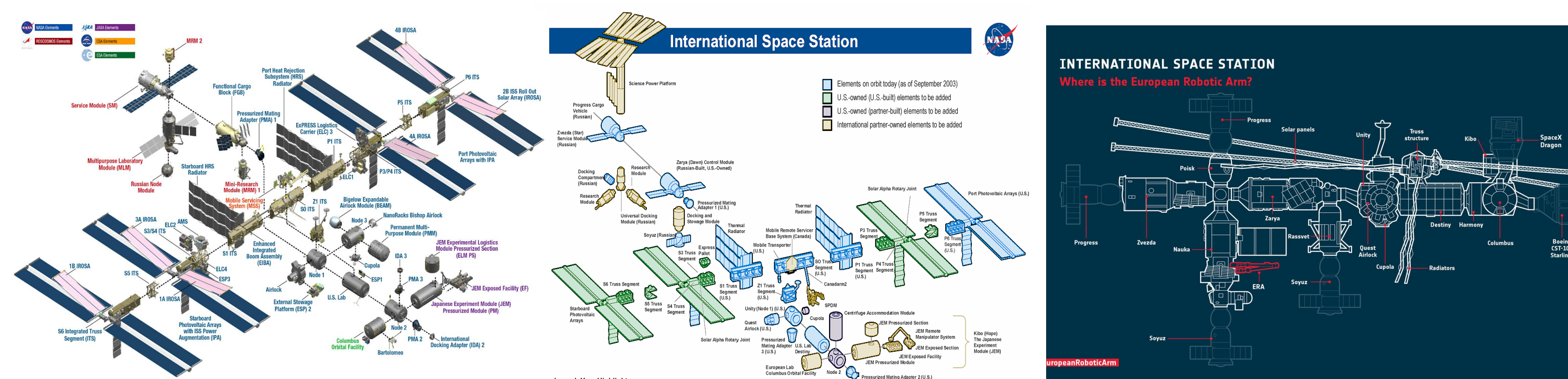
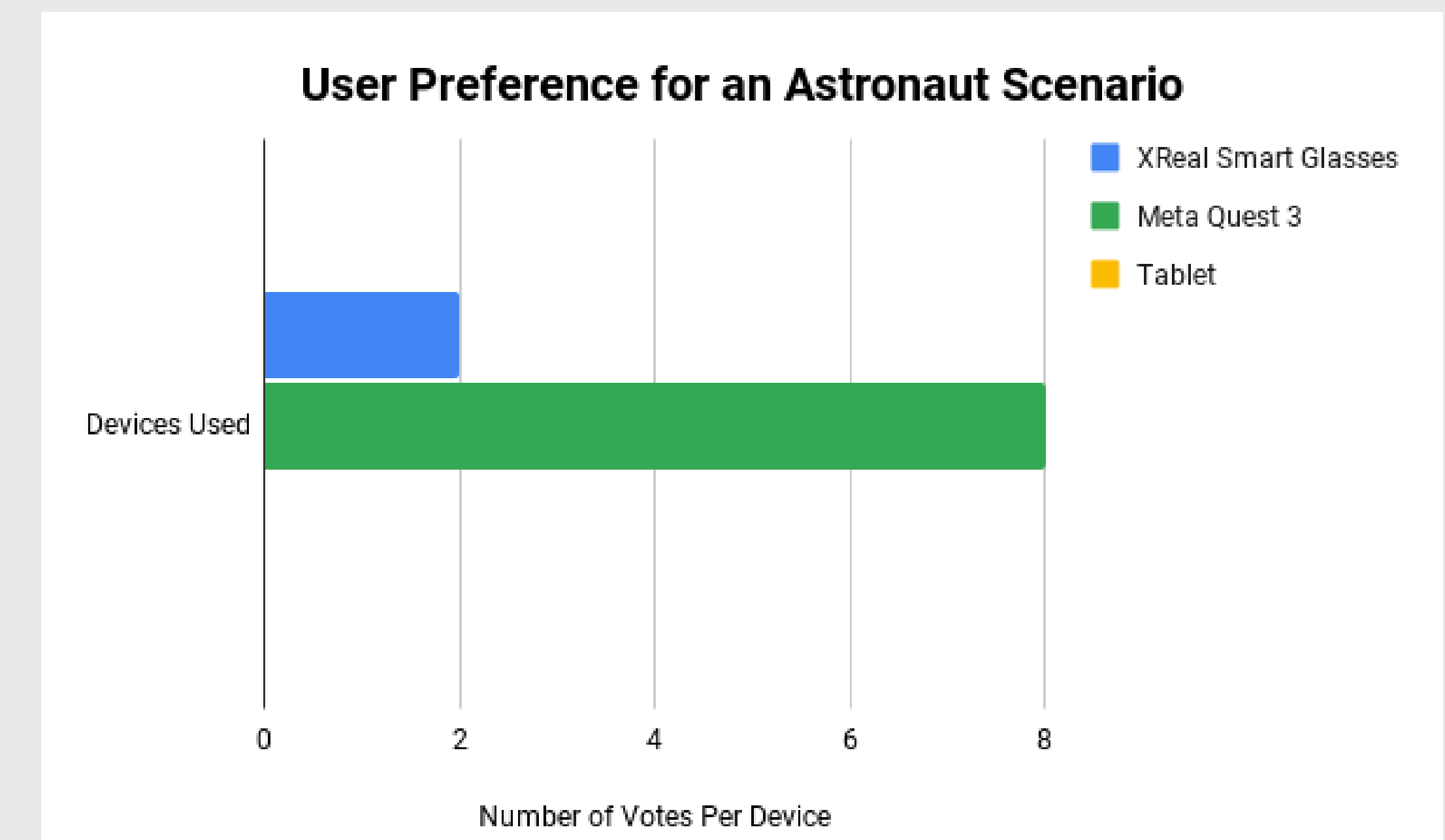
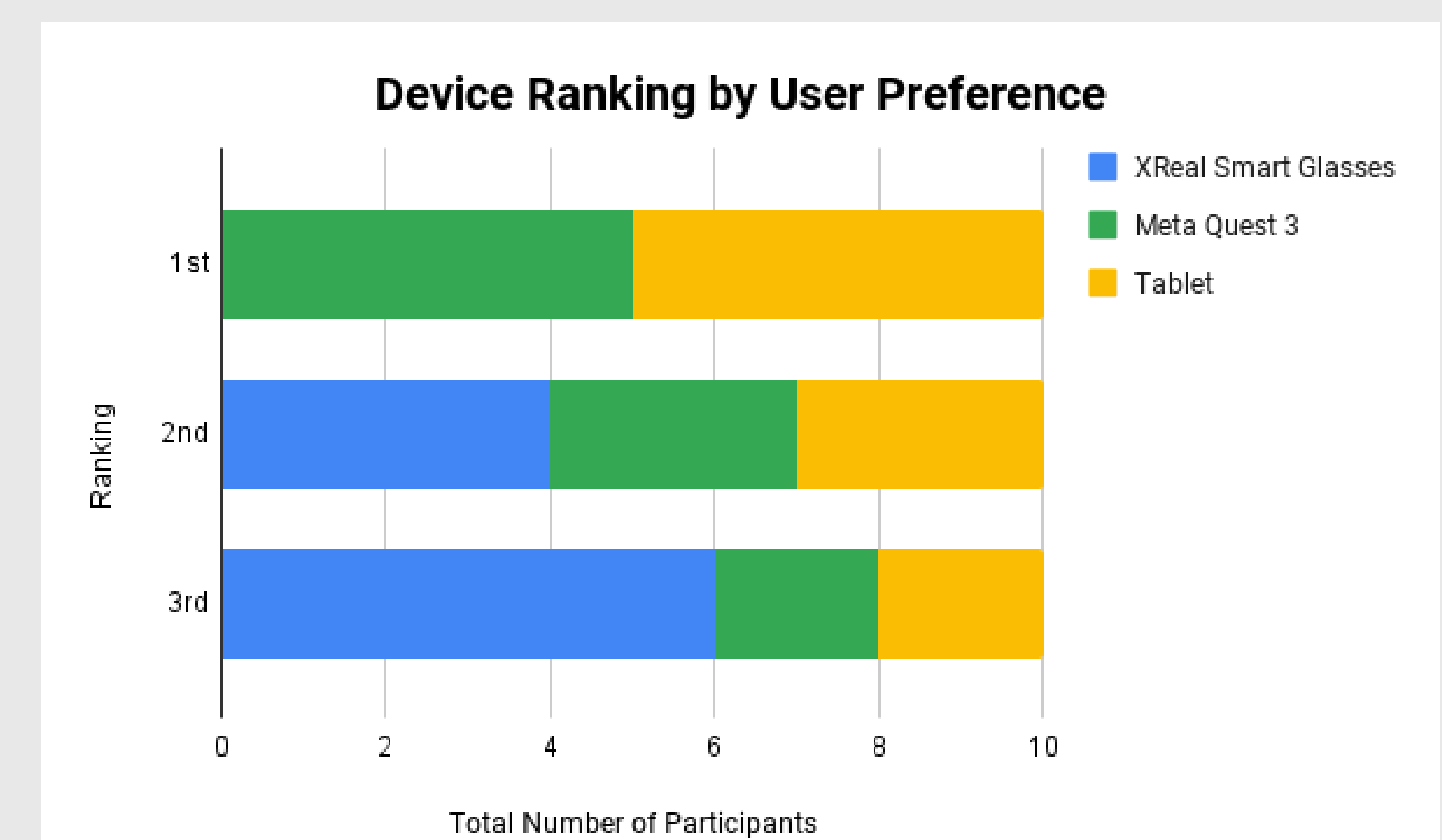


Figure 1. Three schematics of the ISS

Device	XReal Glasses		Meta Quest 3		Tablet	
	Pros	Cons	Pros	Cons	Pros	Cons
Immersion	Good video and audio quality/high resolution Immersive	Screen does not take up entire lens	Highly immersive Stereo system felt more surrounding than the tablet	_____	Use familiarity	Not immersive
Visual/Text Quality	Good text quality	Images are blurry around the edge of the screen	Curved screen made viewing videos easy	Grainy text	Easier to use with glasses High quality resolution	Boring
Comfort	Very lightweight	Causes a significant amount of eye strain after removal Generally uncomfortable to wear and use, especially for those with prescription glasses	_____	Poor adjustability when being worn Heavy on the face	_____	Having to use both hands Could not use for a long time because it was too heavy
Ease-of-Use	_____	Cannot be used like regular sunglasses Cursor did not work well and was too small to see at times "Frustrating, finicky" Cords got in the way during use Limited use range (streaming and reading text)	Accessible for users (can use controllers or hand-tracking) Unique, better novelty Simple to use Has a wide range of use functions	Blurry image and text quality	Less items to carry Can use zoom Has a wide range of use functions Being able to keep it out of one's field of view completely Can hold and feel the screen with your hands	_____

Results

Findings offered insights as to which devices were preferred by users for the task of streaming and viewing schematics and which they thought would be preferred by astronauts for those tasks if they needed to work hands-free.



References

- Brooke, J. (1996). SUS-A quick and dirty usability scale. *Usability evaluation in industry*, 189(194), 4-7.
- Schrepp, M., Hinderks, A., & Thomaschewski, J. (2017). Design and evaluation of a short version of the user experience questionnaire (UEQ-S). *International Journal of Interactive Multimedia and Artificial Intelligence*, 4(6), 103-108.
- Stone, A. (2023). Augmented Reality Takes Agencies to Unexpected Places. *FedTech*. <https://fedtechmagazine.com/article/2023/08/augmented-reality-takes-agencies-unexpected-places>
- Wirth, M., Mehringer, W., Gradl, S., & Eskofier, B. (2012). Extended Realities (XRs): How Immersive Technologies Influence Assessment and Training for Extreme Environments. In *Engineering and Medicine in Extreme Environments*. 309-335. http://dx.doi.org/10.1007/978-3-030-96921-9_14

