Implementing VR/AR technology in low vision rehabilitation

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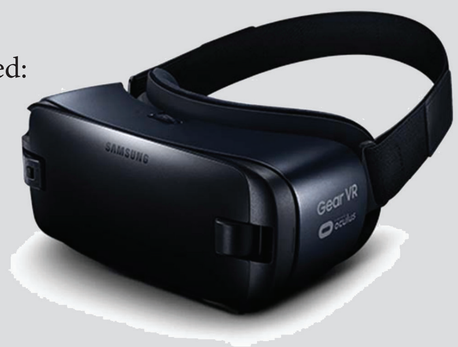
Background

Technological innovations in the field of low vision services usually involve assistive technologies for users with low vision. However technologies can also be used to enhance the experience of these citizens in other ways. A Danish center for low vision services has developed and tested Virtual- and Augmented Reality (VR/AR) technology for communicating a range of different types of visual impairments. One of their concepts has been that the family play a decisive role for the success of a lighting assessment, and whether the recommendations for alterations or arrangements get implemented or not. On the one hand, the visually impaired citizen can be dependent on their social context to help them purchase and install lamps or light bulbs, and on the other hand, some citizens tend to decline the recommendations because of considerations about their household or their colleagues.

Technological development from analouge glasses to Virtual- and Augmented Reality

Communicating visual impairment have previously been mediated by customised glasses, adjusted to a certain visual acuity or specific diagnostic condition. These analouge filters had to be prepared in advance, calibrated and usually represented single conditions.

The VR/AR technology included:
- head mount
- smartphone
- tablet computer
- wireless connection
- software (N-lited)



The digital filters developed as part of the intervention allowed for different conditions to be combined, to adjust the degree of impairment and to demonstrate a course of development.

Methods

The use of the technology was explored as part of an intervention with a recovery-based lighting assessment, along with a narrative interview and light- and visual function assessments in the home environment and later at CSU's lighting lab. The intervention included 60 visually impaired or challenged participants and their relatives, where the VR/AR technology was tested as a way to further include the relative and thereby the social context of the impaired in the rehabilitation.

The role of the VR/AR technology in low vision services is presented and discussed based on observations of the technology employed by two low vision consultants in lighting assessments conducted during the winter season 2018/19, and interviews concerning their experiences from the previous season.

Findings

The visual function was demonstrated by operationalising different fix points in the VR by asking the user to localize a TV-screen showing a picture of a well-known news reporter or a newspaper on the dining table. As the consultant described and demonstrated the impairments in VR and the relative commented on the adjustments, a dialogue was established between the participants.

When the relative was familiarized to the VR, the virtual environment was replaced by AR, and the visual function in the specific home environment. The dialogue guided the consultant to adjust and demonstrate in real time:

> Consultant: *"What can you see when you look at me?"*
> Relative: *"I can see you are blinking your eyes and moving your mouth as you speak…"*
> Impaired: *"Then you see more than me..."*

The participants approached the AR in different ways, some focused on the table and on the faces of us seated around it, others walked across the room, trying to navigate the space. The activities tested were broadly based on the issues described by the visually impaired during the narrative interview.

Compared to the former practice using distorted or deconstructed filters or lenses, the new technology were more flexible and allowed the level of impairment to be adjusted, or several conditions to be combined. The real time demonstration enabled a bodily experience, both from the adjustment of the current condition, the communication of this condition's course of development, as well as exploring the specific physical environment and the effect of different lighting.

By communicating the impairment to the relatives in a way that they perceive the specific visual conditions in real time and in the specific environment, the otherwise abstract and intangible condition get physical and relational. Not all participants appreciated the technology as more than another gadget, however, the virtual environment did engage relatives and resulted in discussions, acknowledgement and recognition of the obstacles at stake.

The findings of this study will support the further use of VR/AR technology in low vision rehabilitation.

Acknowledgements

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