O&M Indoor Virtual Environments for People Who Are Blind: A Systematic Literature Review

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Abstract

BACKGROUND: Knowing their current position in the surroundings constitutes one of the biggest challenges faced by people with visual disabilities when they move around. For them, it is difficult to be aware of the direction in which they are going, and the location of nearby objects and obstacles. In this context, obtaining relevant spatial information is always very significant to these individuals. Hence, the research in the development of assistive technologies for needs and perspectives of people who are blind has been a promising area in terms of the orientation and mobility (O&M) challenges.

OBJECTIVE: The purpose of this study is to systematically examine the literature on O&M virtual environments designed to support indoor navigation to identify techniques for both developing and evaluating the usability and cognitive impact of these applications.

METHODS: A systematic literature review (SLR) was performed, considering population, intervention, outcomes, and study design as eligibility criteria. After a filtering process from 987 works retrieved from six databases, we extracted data from 51 papers, which meet the study selection criteria.

RESULTS: The analysis of the 51 papers describing 31 O&M indoor virtual environments, indicated that O&M virtual environments to support indoor navigation are usually designed for desktop, adopt spatial audio as way to support orientation, and use joystick as primary interaction device. Regarding evaluation techniques, questionnaires, interviews, user observation, and performance logs are commonly used to evaluate usability in this context. In tests involving users, the participants are usually adults aged 21-59 years, who individually spend about 90 minutes split in usually two evaluation sessions. Most papers do not report any strategies to evaluate the cognitive impact of O&M virtual environments on users' navigational and wayfinding skills. Thirteen papers (25.49%) reported the conduction of experiments or quasi-experiments and demonstrated pieces of evidence associated with a positive cognitive impact resultant from O&M indoor virtual environments usage. Finally, only four papers

(7.84%) reported the development of indoor maps editors for O&M virtual environments.

CONCLUSION: Our SLR summarizes the characteristics of 32 O&M virtual environments. It compiles state-of-the-art for indoor simulations in this domain and highlights their challenges and impacts in O&M training. Also, the absence of clear guidelines to design and evaluate O&M virtual environments and the few available computer editors of indoor maps appear as research opportunities.

Palabras clave

Palabras clave de autor: Human-computer interaction; multimodal interfaces; orientation and mobility; people with visual impairment

KeyWords Plus:IMPAIRED PEOPLE; UNKNOWN SPACES; COGNITIVE MAPS; NAVIGATION; TECHNOLOGY; REALITY; REQUIREMENTS; CONSTRUCTION; ORIENTATION; EXPLORATION

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