

DESIGN AND TECHNOLOGY. PEOPLE, ENVIRONMENT, SYSTEMS

AMMIN/CRT/DAD/DENERG - Use of soundscape and sound for space navigation training for persons with visual impairments

Funded By	Dipartimento DENERG Politecnico di TORINO [Piva/CF:00518460019] FONDAZIONE CRT CASSA DI RISPARMIO DI TORINO [Piva/CF:06655250014] Dipartimento DAD
Supervisor	SHTREPI LOUENA - louena.shtrepi@polito.it
Contact	SAVIO LORENZO - lorenzo.savio@polito.it Massimiliano Zampini
Context of the research activity	Persons with visual impairments (PVI), who are approximately 2.2 billion people globally (WHO, 2019), face numerous obstacles while walking, and their safety is often compromised, particularly in complex buildings and urban environments. However, the space design of our built environment is more visually oriented, which makes it harder to live and understand by PVI. Therefore, alternatives such as sound and soundscape result more informative and hearing presents great space navigation potential for PVI who cannot utilize visual clues to navigate in urban and building interiors. This research aims to investigate on different topics (acoustics, neuroscience, and inclusive design) related to perception of the soundscape by PVI and its importance as an accessibility factor.
	The brain's plasticity enables individuals with visual impairments to cultivate additional skills in interpreting auditory signals. However, it is not completely clear yet, if the differences seen in brain might result in superior ability in auditory perception. For PVI different technologies that use feedback for different senses are used. Common modes of feedbacks are audio, tactile, or vibrations. However, audio feedback which is usually given in a navigation system using earphones or speakers, has some disadvantages: the disturbance caused to the user when the information is over-flooded or it may also result annoying when the user misses the environment sounds due to the auditory cues. Furthermore, sometimes technologies designed as wearables for PVI have to deal with social stigma concerns. Given that orientation of PVI inside the buildings also depends on the familiarity of the space, in an unknown interior soundscape can help to extract the information about the place. However, too much noise and reverberation can make the

Objectives	orientation completely impossible. To overcome these limitations, providing the PVI with the possibility of creating and conveying an auditory representation of the surrounding environment ahead of their visit to the actual space could help to train the PVI on the overall spatial perception of the environment. In this context, this research aims to make use of virtual reality, in particular of immersive audio techniques which could render soundscapes allowing for sounds to be localized in direction and distance using headphones or ambisonics technology. More in detail, the PhD research aims to: - investigate the accessibility of PVI to the built environment and their problems and priorities with respect to participation to urban life and to what extent they can share public spaces and urban life; - develop in-field tests to investigate the impact of soundscape conditions PVI accessibility in buildings and urban spaces; - develop laboratory tests making use of virtual reality and spatial audio renderings (auralizations) to investigate the sensitivity of PVI to variations of environmental and architectural conditions; - collect subjective data in-field and in laboratory; - collect data and scenarios from real/existing cases of indoor and outdoor public spaces. - collect data and scenarios from simulated cases and design alternatives to the real indoor and outdoor public spaces; - define usability and accuracy factors; - investigate cognitive load; - define guidelines for soundscape-driven space design; It is expected that the results of this study would contribute to development of social consciousness and inclusion with respect to PVI equal participation to social life and would also guide the efforts that could be made by professionals, institutions and public bodies engaged in the design of public spaces and buildings.
Skills and competencies for the development of the activity	Required and recommended: - Basic knowledge of architectural design, acoustics, and the use of virtual reality systems. - Research management skills, from the conceptual stage to the implementation of an original scientific project, as well as the ability to work independently and collaboratively. - Effective written and oral communication skills with the scientific community, colleagues, and the public.