



UNIVERSITÀ DEGLI STUDI DI TORINO

AperTO - Archivio Istituzionale Open Access dell'Università di Torino

VR4Green: an Immersive and Interactive Virtual Reality Experience for Climate Change Education

This is the author's manuscript
Original Citation:
Availability:
This version is available http://hdl.handle.net/2318/1946796 since 2023-12-12T10:19:18Z
Publisher:
STUDIUM s.r.l.
Terms of use:
Open Access
Anyone can freely access the full text of works made available as "Open Access". Works made available under a Creative Commons license can be used according to the terms and conditions of said license. Use of all other works requires consent of the right holder (author or publisher) if not exempted from copyright protection by the applicable law.

(Article begins on next page)

VR4Green: an Immersive and Interactive Virtual Reality Experience for Climate Change Education *

Alessandro Clocchiatti¹, Federica Cena¹, and Agata Marta Soccini¹

Computer Science Department, University of Torino, corso Svizzera 185, 10149, Italy {alessandro.clocchiatti, federica.cena, agatamarta.soccini}Gunito.it

1 Introduction

The climate crisis has become one of the main challenges of the 21st century [2]. One of the hardest aspects of facing global warming is the difficulty of people to perceive the importance of their personal impact on the environment due to long-term consequences. In this scenario, it is crucial to educate people to adopt pro-environmental behaviors. Virtual Reality (VR) has frequently and effectively been used as an educational tool to change people's behavior on a variety of topics, including climate change awareness. In recent years, several projects focused on promoting and teaching pro-environmental attitudes and strategies through VR. However, the majority of these projects focus on only one specific aspect of climate emergency, such as waste-sorting [4] or dietary footprint [3], or consist in 360° videos [1]. We propose a native interactive VR experience that takes place in the city of Torino, to educate and promote pro-environmental behavior in people's everyday lives. The current work presents the main outcome of analyzing which visual effects within the VR application evoke the most intense emotions in the users.

2 Project description

We defined two main scenarios in which the experience takes place. Firstly, to make the experience feel relevant and familiar to participants, we created a virtual reproduction of the city center of Torino (Figure 1a). Secondly, we modeled a virtual house with furniture and household appliances (Figure 1c). The behavior of the user in the home and their interaction with household appliances produce changes in the surrounding environment, for better or worse. We developed different visual effects in the outside virtual environment to simulate the worsening of environmental conditions (Figure 1b), which directly depend on

^{*} The current work is part of the project "VR4Green: virtual reality solutions to promote environmental awareness and adoption of sustainable behaviors" CUP D11B21005890007. Supported by the National Operative Program (PON) on "Research and Innovation" 2014-2020 of the Italian Ministry of University and Research, and by HST Center (Human Sciences and Technologies) at University of Torino.



Fig. 1: Virtual reproduction of the city center of Turin in good environmental condition (1a), Turin affected by climate change (1b) and the virtual room in which user can interact with furniture and household appliances (1c)

the user's interaction with objects in the room. Specifically, we incorporated the following visual effects into the experience: *pedestrians* coughing and collapsing to the ground, a pervasive *smog* enveloping the landscape and obscuring distant buildings, scattered *trash* and garbage surrounding the city, *building* facades becoming dirtier due to smog, a gradual decrease in *river* water levels, *birds* falling to the ground and *trees* losing their leaves over time.

The aim of the project is to increase participants' awareness of their individual impact on climate change by reducing the temporal gap between their actions in the room and their corresponding consequences on the environment. As our intention is to adopt an emotional learning approach rather than a cognitive one, this paper presents a preliminary study aimed at identifying the visual effects within the application that induce stronger emotions in users.

3 Discussion and Conclusion

We recently run some preliminary user experience tests on the virtual environment of Torino, and collected positive feedback on graphics, sounds, and interaction design. We evaluated the users' perception of the visual effects that compose the dystopian environment through subjective and objective data, and defined participants' emotional responses to several critical situations (collected through PANAS questionnaire [5]). In particular, we grouped the visual effects in three different sets, categorized by their target impact: *human effects*, which impact on man (*pedestrians, smog*); *urban effects*, which relate to urban environments (*trash, buildings*); and *naturalistic effects*, which are connected to nature (*rivers, birds, trees*). We then divided PANAS questionnaire into positive and negative emotions. Results suggest that the naturalistic effect caused the highest negative emotional impact, while human effects lead to unexpected positive emotions.

We are currently testing how much the room environment affects users' attitudes towards environmental problems, and how the cause-effect relationship between actions within the room modifies perceptions of a catastrophic future.

References

- Ferris, K., Garcia Martinez, G., Wadley, G., Williams, K.: Melbourne 2100: Dystopian virtual reality to provoke civic engagement with climate change. In: Proceedings of the 32nd Australian Conference on Human-Computer Interaction. pp. 392–402 (2020)
- Masson-Delmotte, V., Zhai, P., Pörtner, H.O., Roberts, D., Skea, J., Shukla, P.R., et al.: Global Warming of 1.5° C: IPCC Special Report on Impacts of Global Warming of 1.5° C above Pre-industrial Levels in Context of Strengthening Response to Climate Change, Sustainable Development, and Efforts to Eradicate Poverty. Cambridge University Press (2022)
- Plechatá, A., Morton, T., Perez-Cueto, F.J., Makransky, G.: A randomized trial testing the effectiveness of virtual reality as a tool for pro-environmental dietary change. Scientific Reports 12(1), 14315 (2022)
- Stenberdt, V.A., Makransky, G.: Mastery experiences in immersive virtual reality promote pro-environmental waste-sorting behavior. Computers & Education 198, 104760 (2023)
- Watson, D., Clark, L.A., Tellegen, A.: Development and validation of brief measures of positive and negative affect: the panas scales. Journal of personality and social psychology 54(6), 1063 (1988)