27th International Conference on 3D Web Technology

Environmental and sanitary impacts of the "metaverse"

Organizer: Alexis Souchet, Ph.D.

1. Sanitary impacts session (2 hours)

Aim

The "metaverse" induces side effects [1]. The VR community, by extension, people willing to contribute to the "metaverse," should better acknowledge those side effects' existence. To better consider current knowledge about side effects, we propose two interventions to communicate the state-of-the-art French and American scientific communities' ways to address those issues. We will invite two scientists working in human factors to present overviews on the issue. They will answer questions from the audience. Then, a roundtable between the two speakers, the chairman, French associations, and companies' representatives will try to define a roadmap to understand better and tackle VR side effects.

Structure

Talk 1 (25 minutes)

The French Agency for Food, Environmental and Occupational Health & Safety (ANSES) published an expertise report [2] on Augmented and Virtual Reality's sanitary effects. Jean-Marie Burkhardt, who supervised the report, will present the conclusions and his viewpoint on the current status regarding the "metaverse" side effects.

Q&A 1 (5 minutes)

The audience is invited to ask questions to Jean-Marie Burkhardt. The chairman moderates and distributes talking time.

Talk 2 (25 minutes)

Peter Hancock will present an overview of the ergonomics of XR. Then, how the Human Factors and Ergonomics Society and the International Ergonomics Association in the USA are working on those issues.

Q&A 2 (5 minutes)

Roundtable 1 (30 minutes)

The main issues on the table:

1) What do you think is the current level of knowledge about the "metaverse" side effects?
   a. Psychologically
   b. Physiologically
   c. Sociologically
   d. Ergonomics at the workplace (replacing PC?)
   e. General health for mainstream use (video games, etc.)
2) What should be done scientifically to assess the "metaverse" side effects better?
3) What is companies' current status regarding the "metaverse" side effects?
4) What would you put in a roadmap to understand better, assess, and consider side effects in building the "metaverse"?

Objectives

1) Rising XR community's awareness of sanitaire issues with XR.

2) Defining a global roadmap to tackle XR side effects with shared work by scientists, associations, and companies

2. Environmental impacts session (2 hours)

Aim

The metaverse [3], [4], a collection of digital technologies, like any others, has an environmental impact [5], [6]. Almost no contributions specifically treated those issues to that date except for standalone studies [7]. To better consider the current lack of knowledge about the metaverse environmental impact, we propose two interventions to communicate the state of ignorance. In the first talk, one representative from the ADEME will present current knowledge on digital's impacts on the environment. In the second talk, Alexis Souchet will specifically focus on how current knowledge on digital environmental issues can be projected for the metaverse. Then, the speakers, French associations, and companies' representatives will try to define a roadmap to understand better and tackle the metaverse environmental impacts.

Structure

Talk 3 (25 minutes)

Digital technologies are often listed as part of the solutions that align with the Paris agreement regarding CO_2 pollution and climate change. However, digital technologies also have an impact on the environment. Smartphones, computers, data centers, and IoT depends on minerals, metals, chemicals, oil, coal, plastics, logistics, electricity, soil surface, machines, and human work… to be produced and used. What do we know about the environmental impact of digital technologies and how the ADEME is helping the French territory better to consider environmental variables in its economy and industry?

Q&A 3 (5 minutes)

The audience is invited to ask questions to the ADEME's representative. The chairman moderates and distributes talking time.

Talk 4 (25 minutes)

Works exist to assess digital technologies' environmental impacts. But the metaverse is absent from most considerations and current industries, and researchers little tackle those issues. First, I will introduce general knowledge of ecological crises based on current scientific consensus. Then, I will present the state of ignorance about life cycle analyses of hardware and software related to the metaverse. Finally, I will determine the "approximate size" of the metaverse environmental impacts depending on use scenarios (labs only, companies and labs, public services, mass adoption). Then, I will open questions for the metaverse community. Finally, I will make a call to federate to create methods and tools to assess the metaverse's environmental impacts.

Q&A 4 (5 minutes)

The audience is invited to ask questions to Alexis Souchet.

Roundtable 2 (30 minutes)

Main issues on the table:

1) How to better federate and organize work about the metaverse environmental impact?
2) What "bounce effect" can we expect with the mass adoption of XR technologies?
3) Where to find methodologies, tools, and data for evaluating XR technologies' environmental impacts?
4) How Head-Mounted Display manufacturers are considering environmental impacts (reparability, CO_2 footprint, cloud services…)?
5) How can XR industrial and economic growths integrate environmental limits in their development?

Objectives

1) Rising XR community's awareness of environmental issues associated with the metaverse

2) Defining a global roadmap to tackle environmental issues associated with the metaverse with a shared work by scientists, associations, and companies

3. Expected participants

Talk 1 – Jean-Marie Burkhardt

Jean-Marie Burkhardt, Ph.D., is a Director of Research (Full professor) at the [Gustave Eiffel University](#) in the [Laboratory of Applied Psychology and Ergonomics (LaPEA)](#). He obtained a doctorate in cognitive ergonomics from the University of Paris 5 in 1997 and a habilitation to direct research (HDR) from the University of Aix Marseille in 2010. He develops research in ergonomics and psychology on two axes: on the one hand, studies on activities, risk factors, and accident prevention in the field of mobility - in particular in the field of guided transport - and, on the other hand, on the design-centered utility of emerging technologies such as virtual, augmented and mixed reality. He coordinated the 2021 [Anses](#) report on the potential health effects of exposure to augmented reality and virtual reality technologies.

Talk 2 – Peter Hancock

Peter A. Hancock, D.Sc., Ph.D. is *Provost Distinguished Research Professor* in the Department of Psychology and the Institute for Simulation and Training, as well as at the Department of Civil and Environmental Engineering and the Department of Industrial Engineering and Management Systems at the [University of Central Florida](#) (UCF). He directs the [MIT^2 Research Laboratories](#) and is Associate Director of the Center for Applied Human Factors in Aviation (CAHFA). Pr. Hancock is the author of over seven hundred refereed scientific articles and publications, writing and editing over twenty books. He is a multiple-term Member of the National Academy of Sciences (NAS) National Research Council's Committee on Human Factors. He has served as Chair and Organizer for several sub-committees. He operated in the [International Ergonomics Association](#) and the [Human Factors and Ergonomics Society](#).

Roundtable 1 – Participants

1) Speakers 1 and 2.

2) Maud Clavier, president of the [CNXR](#).

3) [Kay Stanney](#), CEO of Design Interactive, Inc and former Professor in the University of Central Florida's Industrial Engineering & Management Systems Department

Talk 3 – Raphael Guastavi

Raphael Guastavi is Head of the Products and Material Efficiency Department in the circular economy and waste management at the [French Agency for Ecological Transition (ADEME)](#), a governmental agency. He has been involved in works about digital environmental impacts and sufficiency all over France.

Talk 4 – Alexis Souchet

Alexis D. Souchet is a Postdoctoral researcher at the [University of Southern California](#) - [Institute for Creative Technologies](#) (MedVR and Affective computing) & Associate researcher (Reservist, Officer candidate) at the [Armed Forces Biomedical Research Institute (IRBA)](#) in France - Neuroscience Department, Stress neurophysiology. Before that, he was a Postdoctoral researcher at the [CNRS](#) - [Heudiasyc UMR 7253,](#) working on the European H2020 project [INFINITY.](#) In 2022, he was missioned by the [French Association of Extended Reality](#) (AFXR) to evaluate XR's environmental impacts. He is a member of [Boavizta,](#) which aims to evaluate the environmental impact of digital technologies across organizations. His researches focus on cognitive ergonomics. They aim to measure Cybersickness, Visual fatigue, Cognitive Load, Inhibition, and Stress while Learning or Working in

Virtual Reality with physiological sensors. Machine Learning is also used to work on automatic detection of those.

Roundtable 2 – Participants
1) Speakers 1 & 2.
2) Maud Clavier, president of the CNXR.
3) Representative from Lynx.
4) Representative of the Sustainable Digital Infrastructure Alliance.

4. Format (presentations, open discussion, Q&A, …)
2 presentations, 2 Q&A and 1 Open discussion / Roundtable.

5. Expected duration
Four hours: 2 hours for sanitary impacts, 2 hours for environmental impacts, including the 30 minutes break.

For the detailed timing, see **Erreur ! Source du renvoi introuvable.** section.

6. Current status of the organization (08/12/2022)
All speakers and roundtable participants have been contacted to participate. Waiting for their answers. Hence, the speakers and other participants did not confirm yet.

References
[1]   A. D. Souchet, D. Lourdeaux, A. Pagani, and L. Rebenitsch, "A narrative review of immersive virtual reality's ergonomics and risks at the workplace: Cybersickness, Visual fatigue, Muscular fatigue, Acute stress, and Mental overload," *Virtual Reality*, 2022, doi: 10.1007/s10055-022-00672-0.

[2]   Anses, "AVIS et RAPPORT de l'Anses relatifs aux effets sanitaires potentiels liés à l'exposition aux technologies utilisant la réalité augmentée et la réalité virtuelle," Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail, Maisons-Alfort, France, Avis de l'Anses, Rapports d'expertise collective 2017-SA-0076, Jun. 2021. Accessed: Jun. 28, 2021. [Online]. Available: https://www.anses.fr/fr/node/149881

[3]   L.-H. Lee *et al.*, "All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda," *arXiv:2110.05352 [cs]*, Nov. 2021, Accessed: Dec. 16, 2021. [Online]. Available: http://arxiv.org/abs/2110.05352

[4]   J. Y. Lee, "A Study on Metaverse Hype for Sustainable Growth," *International journal of advanced smart convergence*, vol. 10, no. 3, pp. 72–80, 2021, doi: 10.7236/IJASC.2021.10.3.72.

[5]   Collective, "Lean ICT: Towards Digital Sobriety," The Shift Project, 2019. Accessed: Aug. 03, 2022. [Online]. Available: https://theshiftproject.org/en/article/lean-ict-our-new-report/

[6]   Collective, "Implementing digital sufficiency," The Shift Project, France, 2020. Accessed: Aug. 03, 2022. [Online]. Available: https://theshiftproject.org/en/article/implementing-digital-sufficiency/

[7]   A. S. G. Andrae, "Life Cycle Assessment of a Virtual Reality Device," *Challenges*, vol. 8, no. 2, Art. no. 2, Dec. 2017, doi: 10.3390/challe8020015.