frontiers in Virtual Reality

TYPE Editorial
PUBLISHED 16 March 2026
DOI 10.3389/frvir.2026.1819537

Check for updates

OPEN ACCESS

EDITED AND REVIEWED BY
Anthony Steed,
University College London,
United Kingdom

*CORRESPONDENCE
Salvatore Livatino,
s.livatino@herts.ac.uk

RECEIVED 27 February 2026
ACCEPTED 04 March 2026
PUBLISHED 16 March 2026

CITATION
Livatino S, Wojciechowski A and Liang H-N (2026) Editorial: New frontiers in immersive technologies: expanding the scope of telepresence, monitoring, and intervention.
*Front. Virtual Real.* 7:1819537.
doi: 10.3389/frvir.2026.1819537



# Editorial: New frontiers in immersive technologies: expanding the scope of telepresence, monitoring, and intervention

Salvatore Livatino[1]*, Adam Wojciechowski[2] and Hai-Ning Liang[3]

[1]School of Physics, Engineering and Computer Science (SPECS), University of Hertfordshire, Hatfield, United Kingdom, [2]Institute of Information Technology, Lodz University of Technology, Poland, [3]Computational Media and Arts Thrust, Information Hub, The Hong Kong University of Science and Technology (Guangzhou), Guangzhou, China

KEYWORDS
extended reality (VR/AR/MR), human-system interactions, immersive technologies, telepresence and teleoperation, VR in education

Editorial on the Research Topic
New frontiers in immersive technologies: expanding the scope of telepresence, monitoring, and intervention

Extended Reality (XR)—encompassing Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR)—is rapidly transforming how humans explore, monitor, and intervene in remote, complex, or hazardous environments. When combined with artificial intelligence (AI), immersive technologies offer unprecedented opportunities to enhance telepresence, teleoperation, and human–machine interaction through richer perceptual interfaces, intelligent mediation, and data-driven decision support (Figure 1). This Research Topic was conceived to showcase recent advances at this intersection, with a particular focus on immersive interfaces, mediated observation, and AI-assisted control for real-world applications. Contributions collected in this Research Topic reflect both the technological breadth of contemporary XR research and a shared concern with human-centred design, usability, and real-world impact. Together, they illustrate how immersive systems are moving beyond laboratory demonstrations toward operational contexts such as space exploration, robotic teleoperation, education, and industrial maintenance.

A central theme emerging from this Research Topic is the enhancement of remote perception and action. Goriachev et al. present the development and user evaluation of an immersive light field system designed for space exploration scenarios. Their work demonstrates how light field rendering in VR can support six degrees-of-freedom viewing, offering photorealistic representations of points of interest captured via a robotically controlled camera. Through usability testing with prospective end users at the European Astronaut Centre, the study provides valuable empirical insight into the comparative benefits of light fields versus alternative representations such as 360° imagery and point clouds. Beyond its technical contribution, this paper highlights the importance of authoring pipelines, rendering performance, and experiential fidelity when designing XR systems intended for high-stakes domains.

FIGURE 1
Conceptual illustration of XR-enabled telepresence and teleoperation, where a VR user remotely interacts with and controls an industrial robotic system through immersive interfaces.

Complementing this perspective on immersive visualization, Luo et al. address a persistent challenge in VR-mediated teleoperation: enabling operators to reliably perceive obstacles and spatial structure under difficult lighting and environmental conditions. Their work introduces a visual augmentation approach based on customised edge enhancement, inspired by principles used in night vision systems. Through two controlled user studies involving unmanned ground vehicle teleoperation, the authors show that their method can improve task performance, reduce workload, and mitigate simulator sickness in both daylight and dark environments. This contribution underscores how relatively lightweight image-processing techniques, carefully integrated into VR interfaces, can substantially improve operational effectiveness without requiring expensive sensing or reconstruction pipelines.

Amoroso et al. shift attention to educational contexts by exploring physical education teachers' perspectives on adopting VR in classrooms across four European countries. Using a qualitative, phenomenological approach, the authors reveal cautious optimism among teachers, alongside practical concerns related to infrastructure, training, and technical support. Their findings emphasise that successful XR integration depends not only on hardware availability but also on pedagogical alignment, professional development, and institutional readiness. This study broadens the scope of the Research Topic by highlighting the socio-technical dimensions of XR adoption and the critical role of educators as mediators of immersive learning experiences.

Khanna et al. provide a systematic review of human–system interaction challenges associated with integrating metaverse technologies into industrial maintenance. Drawing on thematic analysis of recent literature, the authors develop a taxonomy spanning usability, data management, accessibility, user experience, technological performance, environmental awareness, and trust. Their work positions user experience as a central determinant of adoption and proposes an interpretive framework linking usability with levels of technological integration. This contribution offers a valuable conceptual foundation for researchers and practitioners seeking to design human-centred industrial metaverse systems that balance technical sophistication with operational practicality.

Taken together, the contributing papers exemplify the Research Topic's core objectives: advancing immersive interfaces for exploration and intervention, enhancing telepresence and teleoperation, and foregrounding human factors in XR system design. They also reveal common challenges that cut across application domains, including perceptual fidelity, cognitive workload, usability, and organisational readiness. Importantly, several contributions demonstrate that impactful innovation does not always require maximal technical complexity; instead, thoughtful integration of visual augmentation, immersive rendering, and user-centred evaluation can yield meaningful gains in performance and experience.

Looking ahead, this Research Topic points to several promising directions for future research. These include tighter integration of XR with AI-driven perception and control, scalable authoring pipelines for immersive content, and longitudinal studies of XR deployment in operational settings. Equally critical is continued attention to human–system interaction, ensuring that emerging platforms remain transparent, trustworthy, and accessible to diverse user groups.

We hope this Research Topic stimulates further interdisciplinary collaboration among XR researchers, AI specialists, designers, and domain experts. By bridging technological innovation with empirical insight and human-centred perspectives, the community can continue to push the boundaries of how immersive systems support exploration, monitoring, and intervention in an increasingly complex world.

## Author contributions

SL: Conceptualization, Writing – original draft, Writing – review and editing. AW: Conceptualization, Writing – original draft, Writing – review and editing. H-NL: Conceptualization, Writing – original draft, Writing – review and editing.

## Funding

The author(s) declared that financial support was not received for this work and/or its publication.

## Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author H-NL declared that they were an editorial board member of Frontiers at the time of submission. This had no impact on the peer review process and the final decision.

## Generative AI statement

The author(s) declared that generative AI was used in the creation of this manuscript. Generative AI was used to generate the image.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.