SHAPEXR 2026: Workshop on Shaping Human-AI-Powered Experiences in XR

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Abstract

This workshop explores the relationship between eXtended Reality (XR), Artificial Intelligence, and Human Factors, focusing on the fundamental principles of Human-Computer Interaction within the Intelligent User Interfaces topic. With the increasing integration of large language models, conversational agents, and autonomous AI services into everyday interactions, XR offers embodied environments that blend language, gesture, gaze, touch, and spatial context. The workshop examines how AI can enable real-time personalization of immersive interfaces, the design of intuitive multimodal interactions with AI agents, and methods for assessing and optimizing human factors such as cognitive load, emotional engagement, and trust. Additional topics include accessibility by design and the social dynamics of AI-enhanced multi-user XR spaces. Positioning XR as both an application domain and a gateway to AI, the workshop fosters research on intelligent, user-centric, and inclusive immersive interfaces.

CCS Concepts

• **Human-centered computing** → *HCI design and evaluation methods*; Accessibility technologies; • **Computing methodologies** → **Artificial intelligence**; *Modeling and simulation.*

Keywords

Human-Computer Interaction, Artificial Intelligence, Human Factor, Extended Reality.

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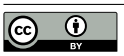

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1 Introduction

Nowadays, the integration of eXtended Reality (XR) and Artificial Intelligence (AI) enables experiences that can evolve from specialized applications to everyday wearable platforms. The realization of AI-powered XR experiences has caused a shift in the design of intelligent and adaptive interfaces and a paradigm shift in the way people interact with these systems. The challenge now is not just to use XR as a target domain for AI-enhanced immersive experiences. Instead, we need to discover new ways to use it as a multimodal, immersive interface for AI systems, including Large Language Models (LLMs), conversational agents, and decision-support tools. This workshop focuses on the potential of these interfaces to transform the way users interact with AI, from hands-free, spatially contextualized dialogue to embodied, gesture-enhanced communication, enabling seamless integration into daily activities. While XR devices increasingly support scenarios from workplace collaboration to rehabilitation, special education, and cultural heritage, they demand highly personalized interactions, a deep understanding of human factors, and a fundamental redesign of interface paradigms. This workshop aims to bring together researchers and practitioners to explore how XR, combined with AI-driven adaptation and rigorous human-centered evaluation, can create intelligent systems that truly augment rather than hinder human capabilities. Discussions will focus on personalization, accessibility, cognitive and emotional load, trust and ethics, and the development of inclusive interaction frameworks for next-generation immersive environments. A special emphasis will be placed on integrating human factors as a core dimension in the design, assessment, and adoption of XR technologies that can leverage AI.

2 Positioning of SHAPEXR within the AI–XR–HCI Landscape

The SHAPEXR workshop represents the first initiative explicitly dedicated to integrating XR, AI, and human factors within the intelligent user interface (IUI) community. While recent events have explored the synergy between AI and XR from complementary perspectives, none have systematically addressed their intersection through an HCI-driven lens. For example, the "Adaptive XAI" (AXAI) workshop held at IUI 2024 and 2025 examined how explainable and adaptive AI techniques can support interface personalization [9, 10]. Similarly, the "Generative AI meets XR" (GenAI-XR) workshop held at IEEE VR 2025 explored the transformative potential of generative AI for XR applications [3]. More recently, the CHI 2025 workshop "Everyday AR through AI-in-the-Loop" began to explore how AI can drive such everyday AR experiences [8]. On this basis, SHAPEXR differentiates itself by framing VR not simply as an application domain, but as an immersive, multimodal interaction layer for advanced AI systems, including LLMs, conversational agents, and decision support tools. This perspective aligns with emerging HCI research on embodied interaction [1], multimodal interfaces [4], and human-centered AI [7], emphasizing the need for fluid, intuitive, and context-aware modes of interaction that support everyday tasks without interrupting them.

One key focus of the workshop is to explore evaluation frameworks for cognitive load in XR systems that assist users in daily tasks requiring interaction with both AI tools and the surrounding environment. These frameworks will help us assess how immersive interfaces affect task performance, attention, emotions, and mental workload in real-world situations. Previous studies on these aspects in VR/AR [5, 11] highlight the need for specific metrics that capture these aspects in dynamic, virtual, and real-world contexts. Another focus of the workshop is exploring how to define robust techniques for analyzing multimodal interaction patterns, including language, gesture, gaze, and haptics, to capture the complexity of human-AI collaboration in embodied contexts. Finally, the workshop aims to outline design principles for AI-enhanced XR applications, based on software engineering and HCI best practices, to support the development of adaptive, accessible, and user-centric immersive systems [2, 6].

3 Workshop Topic

In the context of the intersection between AI and HCI, which has long been exploited within the Intelligent User Interfaces (IUI) community, this workshop specifically addresses the relationship between XR and human factors, emphasizing the potential of XR as a multimodal gateway to AI systems. With the rise of Large Language Models (LLMs), conversational agents, and autonomous AI services, XR environments can serve as rich, embodied interaction layers that merge speech, gesture, gaze, haptic feedback, and spatial context into coherent, human-centered experiences.

The workshop investigates:

- How AI can drive real-time personalization of immersive interfaces that adapt to user states, contexts, and goals;
- Design principles for XR-based multimodal interaction with AI agents, ensuring efficiency, intuitiveness, and minimal cognitive friction;
- Methods to measure and optimize Human Factor, such as cognitive load, emotional engagement, and trust in AI-mediated XR interactions;
- Accessibility by design approaches ensuring inclusivity for users with diverse abilities;
- Social and collaborative dynamics in multi-user AI-enhanced XR spaces.

By positioning XR as both an application domain and a core interface layer for AI, this workshop expands the IUI conversation into richer, more embodied modes of human–AI interaction, aligning with the conference's mission to advance intelligent, user-centered interface research.

3.1 Workshop Format

SHAPEXR 2025 is a workshop held in conjunction with the ACM IUI conference. The workshop aims to foster interdisciplinary discussion and collaboration among researchers and practitioners working in human factors (e.g., psychology, computer science, design), AI, and extended reality (XR). The program is expected to include a mix of invited contributions and participant presentations addressing current challenges and opportunities in exploring embodied AI interactions through XR interfaces. Interactive moments will provide opportunities for participants to exchange ideas, offer feedback, and discuss future research directions, to encourage collaboration and identify emerging themes in this research area.

4 Workshop Contributions

This section presents the research contributions accepted for the workshop, categorized into full-length papers and short papers; short papers have been accepted as posters. The workshop received 11 submissions, of which 5 were accepted as full papers and 2 as short papers. Each submission received two to three reviews. The contributions came from Germany, Luxembourg, Italy, and Israel, demonstrating the widespread interest in the topic. Below, we summarize the key findings and innovations from each paper.

4.1 Full-Length Papers

Inclusive Hand-Based Region-of-Interest Selection Using On-Device Landmark Recognition. The work presents ROI HR, an on-device AI system for smartphones and smart glasses that allows users to select areas of interest through personalized manual configurations, overcoming the limitations of traditional gestures and improving accessibility for people with various motor disabilities. Based on MediaPipe and designed with inclusive principles in mind, the system operates entirely locally, ensuring low latency and privacy, achieves a 98.9% recognition rate on 1,000 images, and will be released as open-source software.

Spatio-Temporal Representation of Eye-Tracking Data for Cognitive Failure Detection in VR. The work explores the possibility of predicting cognitive errors in critical contexts through an extensive VR study based on 50 hours of eye-tracking collected over 18 months from a single participant engaged in arithmetic tasks. The authors propose a lightweight spatiotemporal representation of eye data and test it with different machine learning models, achieving up to 87% accuracy in identifying missed responses. However,

distinguishing correct from incorrect responses is more difficult, likely due to similar eye behaviors and class imbalances. The results demonstrate the potential of personalized AI systems trained on within-subject data and point to VR and deep learning as promising tools for real-time monitoring and adaptive training aimed at reducing human error.

Occlusion-Robust Multimodal Emotion Recognition in VR via Fusion of Facial Images and EMG. The work addresses the limitation of HMDs, which obscure the upper face and make emotion recognition in VR challenging. The authors propose a multimodal system that combines lower face videos with upper face EMG signals, obtained via seven electrodes. On a synchronized dataset of 20 participants, the late fusion of visual embeddings and EMG representations significantly outperforms single-modality models. The results show that occluded-area EMG provides crucial information and enables more reliable emotion recognition in VR, paving the way for adaptive applications such as communication training and therapeutic interventions.

From Multimodal Signals to Adaptive XR Experiences for De-escalation Training. This paper presents the preliminary design of a multimodal system for analyzing real-time user communication as a basis for adaptive VR training. The system integrates five parallel streams—speech analysis, gesture recognition from multi-view RGB cameras, multimodal affective analysis, EEG decoding of mental states, and physiological arousal estimation—synchronized via the Lab Streaming Layer to obtain continuous and aligned assessments of conscious and unconscious signals. An interpretive layer, inspired by social semiotics and symbolic interactionism, links these signals to interactional constructs such as escalation and de-escalation, informed by police instructors and realistic scenarios. Preliminary results from a de-escalation XR project demonstrate the feasibility of automatic signal extraction and the value of multimodal fusion to overcome occlusions and viewpoint limitations, while highlighting that integration and feedback require targeted design choices. The paper offers design resources and empirical guidance for developing AI-based adaptive XR systems in complex interpersonal contexts.

Adaptive Virtual Reality Museum: A Closed-Loop Framework for Engagement-Aware Cultural Heritage. The work proposes an adaptive interface for the consumption of cultural content in VR, capable of automatically modulating the complexity of explanations based on visitor behavior. The system implicitly detects signals such as gaze fixation, head movements, and locomotion, interprets them using an engagement classifier, and uses an LLM to adapt the content depth without interrupting exploration. A field trial at the Ethnographic Museum of Berat (N=16) shows that adaptivity increases engagement and exploration time by 2–3 times, while maintaining high usability. Technical performance guarantees sub-millisecond latency. The preliminary results pave the way for broader studies and raise questions about engagement validation, AI transparency, and the use of generative models in museum contexts.

4.2 Short Papers

Empowering NAO: Overcoming Humanoid Robot Constraints via Large Language Models. The work proposes a system that allows NAO to interact more flexibly using locally executed LLMs. The robot only manages movement execution, while speech recognition, understanding, and behavior generation (including through Python code) are delegated to the models. To ensure reliability and avoid invalid actions, the system integrates a Retrieval-Augmented Generation (RAG) module based on robot-specific structured knowledge. The evaluation, conducted in both conversational and action-oriented scenarios, compares two code-oriented models (CodeLlama 13B and Qwen2.5-Coder 14B). The results show that local LLMs can effectively support adaptive interactions with the user, highlighting the importance of model choice in terms of latency, accuracy in request classification, and task success.

Supporting Medical Doctors with AI-based Smart Wearable Assistance: Case Study of Diagnosis and Therapy Evaluation for Ward Visits. The authors present the design of a wearable intelligent assistance system that combines lightweight smart glasses with a tablet interface to provide contextualized, hands-free clinical assistance during ward activities. The smart glasses provide immediate, hands-free access to essential clinical data via a transparent display; the tablet, meanwhile, facilitates in-depth analysis of complex prognostic variations. A ward case study is presented that illustrates how the level of interaction adapts to contextual conditions, manages uncertainty and noise, and exploits redundancy in sensing and interaction mechanisms. It is shown that priority is given to how, when, and where information is presented, rather than introducing new visualization paradigms.

5 Authors and Affiliations

Giuseppe Caggianese. He is a Research Scientist at the National Research Council of Italy (CNR), Institute for High-Performance Computing and Networking (ICAR), and head of the Augmented Human Computer Interaction Research Group (AHCI). Between 2022 and 2025, he has been a Faculty Board Member of the PhD course on "Technology applied to Cultural Heritage" (TEACH) at the University of Calabria, and between 2014 and 2019, he was an Adjunct Professor of Informatics at the University of Basilicata. He received the Laurea degree in computer science magna cum laude in 2010 and the PhD degree in Methods and Technologies for Environmental Monitoring in 2013 from the University of Basilicata, Italy. His research interests include Human-Computer Interaction, eXtended Reality, and Artificial Intelligence. He primarily focuses on designing and testing advanced interfaces that adapt to specific use cases and user needs in augmented and virtual reality, particularly in the medical and cultural domains. He takes on leadership roles in funded research projects, including Horizon Europe and Italian initiatives, focusing on conversational AI, ICT for health, cultural heritage, and intelligent factories. He authored over 50 scientific papers published in international journals, conference proceedings, and books. He is Associate Editor of the journal Biomedical Signal Processing & Control, member of the Advisory Board for the computer science section of Heliyon Journal (Elsevier), and participates in the program committees of several international conferences and workshops.

Marta Mondellini. She graduated in Psychology at the University of Milan-Bicocca in 2014 and later attended a course in Human-Machine Interaction with a focus on the Human Factor. She is currently a Researcher at the Institute of Intelligent Industrial Systems and Technologies for Advanced Manufacturing (STIIMA CNR) and a Ph.D. student in Psychology at the Catholic University of the Sacred Heart of Milan. Her work mainly focuses on the Human Factor in human-machine interaction, particularly in scenarios related to clinical rehabilitation and telemedicine. She is involved in the validation of Virtual Environments (VEs), investigating aspects such as device acceptability, sense of presence, side effects of immersion, as well as engagement and motivation in treatment through VR. Her research entails collaboration with clinical and multidisciplinary professionals, with the aim of supporting the design of effective and user-centered rehabilitation solutions.

Nicola Capece. He is an Assistant Professor (tenure-track) at the University of Basilicata (Department of Engineering), Italy. His research focuses on Real-Time/Offline Rendering, Artificial Intelligence, Computer Graphics, eXtended Reality, and Human-Computer Interaction. He has authored 49 publications, including international journal papers and conference proceedings. He is an associate editor for a Virtual Reality journal and a guest editor for several special issues in prominent international journals, and he actively contributes to organizing and program committees for international conferences. His projects primarily address XR and HCI applications, including cultural heritage storytelling, virtual dressing rooms, 3D modeling in VR, and gesture recognition systems.

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Gilda Manfredi. She is a Research Fellow at the University of Basilicata, Italy. Her research focuses on Artificial Intelligence, Computer Graphics, eXtended Reality, and Human-Computer Interaction. Her projects explore the application of Artificial Intelligence in creating, animating, and manipulating 3D graphic content for use in XR environments. She authored 17 publications for international journals and conferences.

6 Conclusion and Future Directions

The SHAPEXR workshop at ACM IUI 2026 highlights the emerging importance of human-centered, AI-driven interaction design within immersive XR environments. Discussions in this workshop will contribute to ongoing efforts to rethink how users interact with AI systems as interaction becomes embodied, multimodal, and situated in real-time spatial contexts. The contributions presented illustrate the breadth of challenges and opportunities at the intersection of XR, AI, and human factors.

Future research directions identified through SHAPEXR include the development of robust multimodal sensing pipelines, frameworks for assessing cognitive and emotional load in immersive tasks, and design principles for adaptive XR interfaces that can respond to user states, abilities, and contexts. Further future perspectives include improving accessibility-by-design approaches, supporting neurodivergent users, and exploring ethical and transparent AI behaviors in embodied environments. By fostering collaboration between HCI, AI, XR, cognitive science, and application fields such as education, cultural heritage, and healthcare, future steps aim to shape the next generation of intelligent immersive interfaces—systems that leverage AI to augment human capabilities while preserving usability, inclusivity, and trust.

7 Program Committee

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