CONFERENCE ABSTRACT

2025 THE 11TH INTERNATIONAL CONFERENCE ON VIRTUAL REALITY

ICVR 2025

Wageningen, Netherlands // July 9-11, 2025

- Discovering Virtual Reality, Embracing Future Today -

【Co-sponsored By】

【Hosted and Technical Sponsored By】

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WELCOME MESSAGE

Co-sponsored by Wageningen University & Research, the 11th International Conference on Virtual Reality (ICVR 2025) will be held from July 9th to 11th, 2025, in Wageningen, Netherlands.

Over the past 10 years, ICVR has firmly positioned itself as a prestigious event, drawing multidisciplinary attendees. It has been held in multiple cities worldwide, including Los Angeles, Hong Kong, Singapore, Chengdu, Foshan, Nanjing, and Bournemouth (UK). Each conference has seen a significant rise in participation, enriching the field of Virtual Reality with valuable knowledge, insights, and best practices.

ICVR 2025 is a forum designed to foster collaborations and knowledge-sharing of new advances and developments in VR, AR, and XR among researchers, technical people, domain experts, and academics from around the world. ICVR 2025 invites authors to contribute original works that showcase pioneering research results, transformative projects, surveys, and real-world industrial experiences that make advances in VR and its related fields.

All papers were subject to peer reviews by the conference international committee. The acceptance of the papers is based on their quality and relevance to the conference remits. Accepted papers cover topics ranging from VR display and 360 video technologies to AI in VR to brain-computer interfaces and haptics in VR to Virtual Reality games and UX and culture heritage and VR applications. The ICVR 2025 will be a valuable reference for researchers, educators and developers in Virtual Reality. This year, we are also delighted to have the following invited speakers:

- Marnix S. van Gisbergen, Professor Digital Media Concepts, Academy for AI, Games & Media Digital Media Concepts, Breda University of Applied Sciences, Netherlands
- Anne Hermans, SenseGlove, Netherlands
- Leon Schipper, Chief Executive Officer at Aryzon.World
- Carmen-Silva Sergiou, Postdoctoral researcher GUTS, Youth at risk| GUTS GO cohort

The ICVR 2025 conference is planned in such a way so that researchers can enrich Virtual Reality and its relevant research field through keynotes, tutorials, hybrid presentation sessions, and informal conversations among colleagues from around the world.

On behalf of the conference committee, we thank all the authors, reviewers, and attendees for their contributions and participation in ICVR 2025. Their dedication and expertise enable us to prepare this high-quality program to make the conference a success. Finally, we wish all the delegates a productive and enjoyable conference.

ICVR 2025 Conference Committee

July, 2025

USEFUL INFORMATION

🕮 Time Zone: UTC+2

For Onsite Participants

🕮 Conference Venue

Omnia, Wageningen, Netherlands

Address: Hoge Steeg 2 | Building 105, 6708 PH Wageningen, Netherlands

For more, please visit:
https://www.wur.nl/en/value-creation-cooperation/join-us-on-campus/omnia.htm

Omnia: a space for discussion, inspiration and meeting, Omnia is where scientists, students and society meet. Omnia is situated at the entrance of Wageningen Campus in the heart of FoodValley. We are dedicated to facilitating meaningful dialogues about life sciences and the agrifood sector offering a space for in-depth and open conversations with partners, stakeholders, and society. Our venue hosts small to large groups for symposia, conferences, debates, round-table discussions, PhD graduations, workshops, and receptions. You are also welcome to have a drink, lunch or dinner in the unique in-house restaurant Novum.

🕮 Temperature

Average Temperature in July in Wageningen

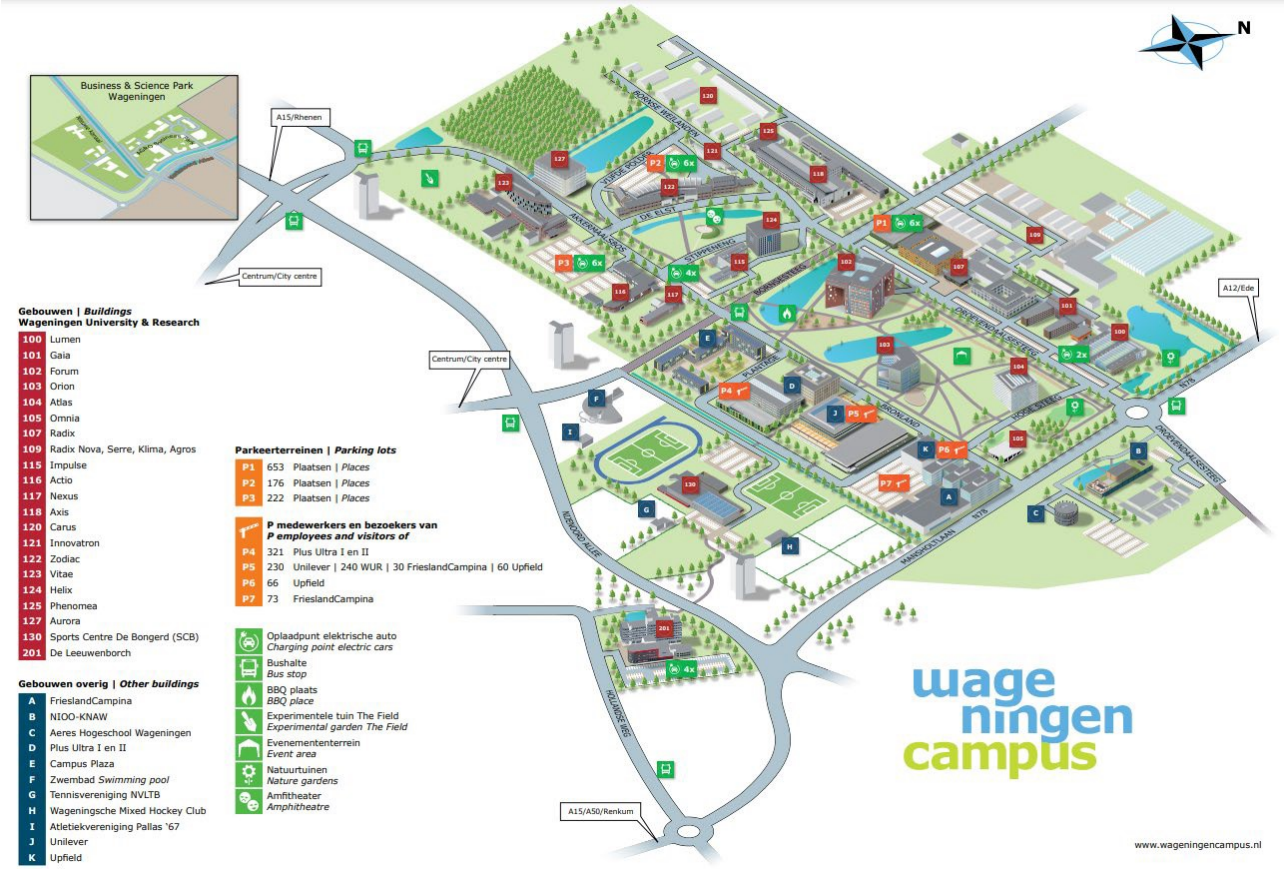
13℃ - 24℃

🕮 Attention Please

♣ Please take care of your belongings in public area. For your personal and property safety, delegates are suggested to wear representative card during conference and not to lend it to those unconcerned to enter event rooms. Conference does not assume any responsibility for loss of personal belongings of participants.

♣ Don't stay too late in the city, don't be alone in the remote area. Be aware of the strangers who offer you service, signature of charity, etc., at scenic spots. You can search more Tourist Information and Security tips online.

🕮 Emergency Call: 112



For Online Participants

🕮 Online Conference Information

- **Zoom Link: https://us02web.zoom.us/j/83792200883**
- **Zoom ID: 837 9220 0883**
- **Password: ICVR**

Note:
Conference rooms will be open 30 mins before scheduled time.
Pls join the online room 10-15 mins before your session starts and be prepared.

Zoom Download: https://zoom.us/

Tips:

- Please unmute audio and start video while your presentation.
- It's suggested to use headset with microphone or earphone with microphone.
- Duration of each Presentation: about 12 Minutes of Presentation and 3 Minutes of Q&A.
- E-certificate will be sent to presenters after conference by email.
- An excellent presentation will be selected from each session and announced on the website after conference. An excellent presentation certificate will be sent after conference by email.
- It's **Netherlands Time Zone** (UTC/GMT +2) for the whole schedule.

Rename your screen name before entering the room	Example
Authors: Paper ID-Name	VR0001-Sam Louis
Keynote Speaker: Keynote-Name	Keynote- Sam Louis
Invited Speaker: Invited -Name	Invited- Sam Louis
Committee Member: Position-Name	Committee- Sam Louis

🕮 Duration of Each Presentation

- ✧ Keynote Speech: 50 Minutes of Presentation including Q&A.
- ✧ Tutorial: 50 Minutes of Presentation including Q&A.
- ✧ Regular Oral Presentation: 15 Minutes of Presentation including Q&A.

Online Pre-test Timetable and online sign in (July 9, 2025)

*Please enter the room 10 minutes before the test session start

Zoom Link: https://us02web.zoom.us/j/83792200883

Zoom ID: 837 9220 0883 Password: ICVR

Test Time (UTC+2)	Online Test
08:30-09:00	Keynote Speakers & Session Chairs & Committees
09:00-10:00	VR01010, VR01017, VR01072, VR01075, VR1014, VR1019, VR1026, VR2043, VR3079, VR1013, VR1015, VR1024, VR2032, VR2057, VR3063, VR3069, VR4101, VR4103, VR01099, VR1027, VR2049, VR2051, VR3068, VR3076, VR3077, VR3078, VR4104

DAILY SCHEDULE

Day 1, July 9, 2025	
10:00-16:00	Onsite Sign in and Collect Conference Materials **Location: Omnia, Catering Area**
15:00-16:00	Campus Tour & NPEC tour & Unifarm Tour Refer to below link to get related Tour information, and contact corresponding Tour Guide if necessary. Link: http://hgg922om6hjbwthb.mikecrm.com/6RSvgaf

Day 2, July 10, 2025	
Morning Program-Location: Momentum 2+3, Omnia **Zoom: https://us02web.zoom.us/j/83792200883 password: ICVR**	
Host: Prof. William Hurst, Wageningen University & Research, Netherlands	
09:00-09:05	**Welcome Message** **Prof. Dick de Ridder, Wageningen University & Research, Netherlands**
09:05-09:10	**Opening Remarks** **Prof. Wen Tang, Bournemouth University, UK**
09:10-10:00	**Keynote Speaker I** **Marnix S. van Gisbergen, Professor Digital Media Concepts, Academy for AI, Games & Media Digital Media Concepts, Breda University of Applied Sciences, Netherlands** **Speech Title: A Digital Déjà Vu known as Virtual Reality**
10:00-10:30	***Group Photo & Coffee Break***
10:30-11:20	**Keynote Speaker II** **Anne Hermans, SenseGlove, Netherlands** **Speech Title: From Virtual Seeing to a Fuller Virtual Reality: Bringing the Sense of Touch into the XR Mix**
11:20-12:10	**Keynote Speaker III** **Leon Schipper, Chief Executive Officer at Aryzon.World** **Speech Title: 3D learning and neurodiversity**
12:10-14:00	***Break & Lunch***
14:00-14:50	**Keynote Speaker IV** **Carmen-Silva Sergiou, Postdoctoral researcher GUTS, Youth at risk| GUTS GO cohort** **Speech Title: Using Virtual Reality in Criminology research and the road ahead Virtual reality-based retrospective think aloud (VR-RTA): a novel method for studying offender decision-making**

14:50-15:40	**Tutorial** **Santiago Berrezueta, Technical University of Munich (TUM), Germany** **Speech Title: Integrating AI with Meta Human Avatars in Unreal Engine**
15:40-16:00	***Coffee Break***
16:00-17:45	**Onsite Session A** ..... ***Momentum 2+3, Omnia*** **Topic: Mixed Reality and Virtual Environment Design** **Session Chair: Dr. Caspar Krampe, Wageningen University & Research, Netherlands** VR1016, VR01008, VR01021, VR01023, VR01070, VR2042, VR2048
18:20	***Dinner***

Day 3, July 11, 2025

Onsite Sessions

Location: Momentum 2+3, Omnia

10:00-11:45	**Special Session 2** ..... ***Momentum 2+3, Omnia*** **Topic: Food XR – Immersive Technologies for Food and Nutrition Studies** **Session Chair: Prof. Alexander Klippel, Wageningen University & Research, The Netherlands** VR02046, VR02053, VR02054, VR02088, VR02092, VR02095, VR02096
11:45-13:30	***Lunch***
13:30-15:15	**Onsite Session B** ..... ***Momentum 2+3, Omnia*** **Topic: AI based Virtual Simulation and Virtual Device Development** **Session Chair: Assoc. Prof. Andrés Trujillo-León, Universidad de Málaga, Spain** VR1005, VR1020, VR2040, VR2045, VR3066, VR3083, VR4105
15:15-15:45	***Coffee Break***
15:45-17:15	**Onsite Session C** ..... ***Momentum 2+3, Omnia*** **Topic: Multi Sensory based Virtual Reality and Simulation Technology** **Session Chair: Prof. Edward Huijbens, Wageningen University & Research, Netherlands** VR1002, VR1009, VR1012, VR1018, VR2036, VR3087

Online Sessions

Zoom: https://us02web.zoom.us/j/83792200883 password: ICVR

09:30-11:45	**Online Session 1** ..... **Zoom: 837 9220 0883** **Topic: Virtual Reality and Immersive Experience based on Vision** **Session Chair: Assoc. Prof. Xiangdong Li, Zhejiang University, China** VR01010, VR01017, VR01072, VR01075, VR1014, VR1019, VR1026, VR2043, VR3079

11:45-13:00	*Break Time*
13:00-15:15	**Online Session 2 ..... Zoom: 837 9220 0883** **Topic: AI-driven Mixed Reality and Multimedia Application Technology** **Session Chair: Prof. Dorota Kamińska, Instytut Mechatroniki i Systemów Informatycznych Politechniki Łódzkiej, Poland** VR1013, VR1015, VR1024, VR2032, VR2057, VR3063, VR3069, VR4101, VR4103
15:15-15:45	*Break Time*
15:45-18:00	**Online Session 3 ..... Zoom: 837 9220 0883** **Topic: Innovative Application of Modern Virtual Technology in Information System** **Session Chair: Prof. Tilemachos Koliopoulos, Collaborator University of West Attica, Greece** VR01099, VR1027, VR2049, VR2051, VR3068, VR3076, VR3077, VR3078, VR4104

KEYNOTE SPEAKERS

Marnix S. van Gisbergen

Professor Digital Media Concepts, Academy for AI, Games & Media Digital Media Concepts
Breda University of Applied Sciences, Netherlands

Onsite Location: Omnia, Momentum 2+3, Omnia

Boi: Marnix van Gisbergen is professor 'Digital Media Concepts' and R&D manager at Breda University of applied Sciences (Academy of AI, Games and Media). He is also jury member of the European Digital Communication Awards (2017-), Curator board member (2019-) of Chronosphere (Volumetric Capturing collaboration), co-founder and researcher in Experience lab (BUas) and was a Professor Media Enriched Sport Experiences (powered by ZIGGO and Hilversum Municipality). As a research director (2005-2012) of a research agency DVJ Insights and youth company YoungVotes he was responsible for the initiation and management of media related research projects for over 75 brands (e.g., RTL, MTV Networks, Sony BMG). Within the central program line 'Contextual Connected Media' the main R&D goal in his professorship is to help brands to realize an immersive media (VR, AR, XR). With an international team of media researchers, game developers and students, Marnix is involved in several innovative media related National and European funded projects on topics such as virtual reality, human body sensors, transmedia and new media business models. Over 40 national and international funded projects have been acquired, created and tested around immersive media projects with a total value over €15M. This includes projects for and with organizations such as Aegon, Heinz, Samsung, Sony, United Nations, Schola Medica, Thermo Fisher, Novadic Kentron, PSV, KOOLE, , Noldus, BLueTea, VisionaiR3D and several museums, hospitals (Stichting Amphia, Stichting Spaarne Gasthuis) and broadcasters such as Google, YouTube, NPO, Warner Music, DPG Media, JIC BRO, 4DRStudio, Effenaar, and Banijay. This has led to over 300 output deliverables and Industry magazines and key-notes, as well as digital media products ranging from VR Supermarket, VR museums, VR/AR entertainment and Virtual Human applications for games, films, ads, news, brand, HR, sport and dance experience

Speech Title: A Digital Déjà Vu known as Virtual Reality

Abstract: We can in 2025 safely argue that VR an AR will not disappear, despite skeptical articles that refer to the decline of XR in the (recent) past. We will spend a significant proportion of our time inside a mediated digital Virtual Reality. However, the question is how much time and with what purpose? Due to the increasing number of media, selection of a medium becomes increasingly more complex and important. Especially as we do not suddenly get more time to spend on media and as budgets for organizations do not increase with the same speed as media arise. Hence, the key question is what kind of role VR will have. What is the added value of VR compared to other media? In this key-note we will discuss what we have learned so far from a decade of developing and testing VR products and strategies. We will discuss the findings behind VR adoption (and rejection), based on the 5-C adoption model and the Virtual Reality reward-effort paradox. We will share the optimum design of VR to create experiences and stir behaviour reflecting on the 4 VR technology model and the 5-P presence model. We will discuss the role of realism based on virtual human experiences. The audience can choose in which context they like to discuss these: from health to entertainment, and from sport to training and education.

KEYNOTE SPEAKERS

Anne Hermans

SenseGlove, Netherlands

Onsite Location: Omnia, Momentum 2+3, Omnia

Boi: Anne Hermans is the Chief Technology Officer at SenseGlove, a Dutch company developing wearable haptic force-feedback gloves that facilitate intuitive interactions in XR for training and telerobotic operations. With a background in Industrial Design Engineering, Mechanical Engineering and Biomechanical Design, she currently leads the multidisciplinary Research and Development team, bringing a human-centered perspective to advanced XR solutions. Anne is passionate about preserving meaningful human experience in an increasingly digital world, and her work reflects a commitment to bridging the physical and virtual through intuitive, haptic-enabled interaction.

Speech Title: From Virtual Seeing to a Fuller Virtual Reality: Bringing the Sense of Touch into the XR Mix

Abstract: As XR technologies continue to evolve, visual and auditory advancements often steal the spotlight, overlooking the sense of touch as a vital part of our interface with the world. This keynote will begin by examining why touch matters and what it can add to your XR applications. From vibrotactile cues and kinaesthetic force feedback to thermal signals and contact-based interactions, this talk will 'touch upon' the spectrum of haptic technologies and their practical applications in XR. Haptics can imitate reality, enhance immersion, or even speculate new sensations altogether. We'll compare general-purpose solutions like haptic gloves to specialized devices; discuss design dimensions like actuator resolution, latency, and feedback fidelity; and consider how to align haptic goals - immersion, skill transfer, realism - with your simulation requirements. The session concludes with seven practical steps for integrating haptics into any XR workflow.

KEYNOTE SPEAKER

Leon Schipper

Chief Executive Officer at Aryzon.World

Onsite Location: Omnia, Momentum 2+3, Omnia

No-coding XR tool bringing all neurotypes together!

Boi: Leon Schipper is serial entrepreneur and currently the Chief Executive Officer of Aryzon.World. Aryzon.World makes XR technology accessible for everyone. We focus on co-creation, visual learning, and inclusivity—with special attention for neurodivergent individuals and people who benefit from non-linear ways of working and learning. We dream of a future in which XR is widely used to help people learn, create, and collaborate. Not as a niche technology, but as a human bridge between ideas, worlds, and possibilities. Leon has a Master's degree in Industrial Design Engineering (UTwente, NL), a real multidisciplinary innovator and team leader at the intersection of technology, people & societal impact From nature-inspired molecular detection to co-creating educational XR experiences with neurodiverse talent – he brings vision, structure, and impact to complex, multi-stakeholder environments.

His mission: to contribute to a more inclusive future where everyone has the chance to learn, grow, and make a difference.

His Motto: “Rest, love and peace is everything that mankind needs.

Speech Title: 3D Learning and Neurodiversity

KEYNOTE SPEAKER

Carmen-Silva Sergiou

Postdoctoral researcher GUTS
Youth at risk| GUTS GO cohort

Onsite Location: Omnia, Momentum 2+3, Omnia

Boi: Carmen-Silva Sergiou is a forensic neuroscientist that works as a postdoctoral researcher at Amsterdam UMC at the youth at risk department as part of the GUTS project. The GUTS project is a longitudinal study that follows the brain development and social behavior of youth at risk that already have police contact or display early signs of antisocial behavior, already at age 10-13 for 7 years. Carmen's research focuses on the psychological and neural processes involved in aggression and emotion regulation in forensic populations. Her previous work focused on using innovative research methods to investigate (or modulate) criminal decision-making using neuromodulation or Virtual Reality (VR). She aims to integrate neuroscience with technology in her research line FORNEUROTECH. She will talk about a method she developed together with colleagues at the Max Planck Institute for Crime, Security and Law on using Retrospective Think Aloud protocols in combination with VR with a sample of incarcerated burglars.

Speech Title: Using Virtual Reality in Criminology research and the road ahead
Virtual reality-based retrospective think aloud (VR-RTA): a novel method for studying offender decision-making

Abstract: This study introduces and evaluates a novel approach to studying decision-making: Virtual Reality-Based Retrospective Think-Aloud (VR-RTA). Designed to capture offenders' perspectives, VR-RTA enhances memory recall and information elicitation by combining immersive technology with retrospective reporting. Background: Ideally, researchers would be present at the moment an offense takes place and study offenders on the job, but ethical, practical, and safety considerations generally render this option unfeasible. One way to address some of the challenges plaguing retrospective research methods, such as interviews and surveys, is to reinstate the context of that behavior using immersive technologies, such as virtual reality (VR) that allow for studying behavior in real time. This allows for a realistic simulation of criminogenic environments, which offenders can navigate to demonstrate decision-making under circumstances resembling the conditions of a controlled behavioral experiment in a safe and ethical way. Methods: VR-RTA was implemented with 200 incarcerated burglars, who explored virtual neighborhoods in immersive VR equipped with eye-tracking. Participants scouted for burglary opportunities, then reviewed screen recordings of their exploration while verbalizing their assessments and decision-making strategies. Emerging themes from these sessions were further examined in interviews and linked to survey data. Eye-tracking data provided insights into participants' attention to environmental features, identifying both deterrent and attractive cues, and were triangulated with qualitative and quantitative findings. Results: The method yielded detailed insights into participants' environmental assessments and decision-making strategies. VR-RTA facilitated the articulation of cognitive processes that are often automatic, while also fostering participant engagement through rapport-building.

Conclusions: VR-RTA is a promising multi-method tool for studying real-time decision-making in crime commission. By addressing limitations of traditional retrospective methods, such as interviews and surveys, and leveraging the capabilities of immersive technologies, VR-RTA has the potential to advance criminological research and understanding of offender behavior.

TUTORIAL

Santiago Berrezueta

Technical University of Munich (TUM), Germany

Onsite Location: Omnia, Momentum 2+3, Omnia

Bio: Dr. Jonnathan Santiago Berrezueta Guzman is an interdisciplinary researcher at the Technical University of Munich, specializing in trustworthy AI, educational data science, and immersive technologies. With a background in software engineering, robotics, and virtual reality, his work focuses on designing inclusive, adaptive systems to support neurodiverse and vulnerable populations. He has authored over 40 peer-reviewed publications and led projects involving robotic assistants, AI-driven therapies, and smart learning environments. His research has earned multiple awards and is driven by a commitment to ethical, human-centered design in education and health technology.

Research Topics & Interests: Virtual Reality / Augmented Reality, Artificial Intelligence, Interactive Learning

Title: Integrating AI with Meta Human Avatars in Unreal Engine

Abstract: This tutorial demonstrates how to integrate AI-driven characters with MetaHuman avatars in Unreal Engine 5 to create interactive, lifelike virtual agents. The objective is to guide developers through the complete workflow of linking large language models (LLMs) or dialogue systems with high-fidelity MetaHumans, enabling them to perceive user inputs, generate intelligent responses, and deliver them through natural voice and facial animations. By combining cutting-edge AI with real-time rendering, this approach unlocks powerful applications in virtual storytelling, immersive education, training simulations, and therapeutic environments. In the end, the attendants will also have access to the take-away material to try out the implementation demonstrated in the tutorial.

ONSITE SESSION A

- **Topic: Mixed Reality and Virtual Environment Design**
- **Time: 16:00-17:45, July 10, 2025 | UTC/GMT+2**
- **Place: Momentum 2+3, Omnia**
- **Session Chair: Dr. Caspar Krampe, Wageningen University & Research, Netherlands**
- **VR1016, VR01008, VR01021, VR01023, VR01070, VR2042, VR2048**

VR1016 **16:00-16:15**	Title: Evaluating User Perception of String-Based Force Feedback in Virtual Cable Routing Author(s): Knittel Emanuel, Matthias Wölfel, Achberger Alexander, Presenter: Matthias Wölfel, University of Applied Sciences Karlsruhe, Germany Abstract: Virtual cable routing is one of the most cost-intensive processes in the development of electro-mechanical products. Current approaches use virtual reality to enable users to route cables interactively. However, existing systems provide only visual feedback, with haptic feedback still largely absent. This paper examines the benefits and drawbacks of integrating haptic feedback into cable routing tasks. It utilizes the string-based force feedback device STRIVE to simulate the maximum cable length haptically. A user study with 31 participants was conducted under different feedback conditions. Results indicate that string-based force feedback enhances realism, immersion, precision, and user support but reduces mobility and comfort. However, the extent of its impact varies depending on the feedback configuration and type of task.
VR01008 **16:15-16:30**	Title: The Impact of Job Role and Training Method on Self-Efficacy: Comparing Simulation-Based and Virtual Reality Emergency Training for Stadium Wardens Author(s): Hans Stefan, Michael Mortimer, Ben Horan, Brad Wright Presenter: Hans Stefan, Deakin University, Australia Abstract: Competent and confident wardens play a critical role in managing effective responses during an emergency, especially in large-scale venues such as sports stadiums. Warden emergency preparedness training serves as an effective tool for wardens to become familiar with emergency procedures and improve their self-efficacy. Simulation-based training (SBT) is considered effective by recreating emergency scenarios, although its heavy resource requirements can limit its use. Virtual reality training (VRT) offers an alternative that is safe, repeatable, and cost-effective, with growing evidence showing potential benefits to training outcomes. However, few studies have investigated the impact of VRT in improving the self-efficacy of wardens, especially in sports stadium settings, or compared its outcomes with established methods such as SBT. In this study, self-efficacy was measured before and after SBT and VRT for two groups: chief warden (CW) and area warden (AW), who have different emergency response roles and responsibilities. SBT led to consistent, role-independent self-efficacy gains, reaffirming its position as a reliable and widely applicable training method, while VRT results suggested benefits were role-specific. AW participants showed greatest increase in self-efficacy in response to VRT while CW showed greatest increase in response to SBT, suggesting the importance of aligning training methods with job roles. A multi-modal approach is likely to benefit warden training where VRT is used as a scalable, introductory mode for cross-functional staff that require fundamental understanding of emergency response procedures and SBT is used to practice those emergency procedures in a group-based environment focused on the different roles and responsibilities.
VR01021 **16:30-16:45**	Title: Applying Mixed Reality for Surveying Exercises: Integrating Surveying Instruments in VR-CAVEs Author(s): Fabian Püschel, Aida Yousefi, Carina Justus, Klaus Böhm Presenter: Fabian Pueschel, University of Applied Sciences Mainz, Department of Technology Abstract: This paper examines the technical feasibility of integrating a real total station

	into a VR-CAVE environment to facilitate mixed-reality surveying exercises. The developed Mixed Reality Surveying CAVE (MRS-CAVE) prototype combines physical interaction with a real total station and immersive virtual environments to provide students with hands-on surveying experiences in various scenarios. The system is based on a cost-effective VR-CAVE setup that utilizes synchronized physical and virtual coordinate systems, enabling precise positioning and orientation of the total station within the virtual environment. The orientation of the telescope is captured using a motion-sensor-equipped controller, enabling virtual measurements of angles and distances to be performed in real time. The application facilitates the implementation of diverse virtual and realistic surveying scenarios, such as volume calculations for excavation pits or bridge staking, tailored to the respective virtual environment. These scenarios provide students with the opportunity to acquire practical skills in operating surveying instruments and to train typical workflows in a realistic manner. Furthermore, professors can supervise and guide the exercises directly within the VR-CAVE, fostering an interactive and immersive learning environment. Initial tests at a school of geoinformatics and Surveying at a German university demonstrate that the MRS-CAVE prototype enables precise and practical implementation of typical surveying tasks. Limitations, such as sensor drift and the restricted field of view through the real telescope, were successfully mitigated by means of calibration mechanisms and virtual aiming aids. The findings highlight that VR-CAVEs are a promising platform for education in the field of surveying. In particular, the ability to collaborate with multiple users within the VR-CAVE space and to simulate real-world roles, such as field book management and target point acquisition, emphasizes the system's potential. The MRS-CAVE prototype opens new opportunities for immersive and practice-oriented training scenarios, bridging the gap between virtual simulation and physical surveying.
VR01023 **16:45-17:00**	Title: VV Editor - A Tool for Creating Volumetric Video Trainings for Extended Reality Author(s): Nora Kießling, Erik Freydank, Lina Seyfried, Dr. Maiara Rosa Cencic Presenter: Erik Freydank, Fraunhofer IPK, Germany Abstract: This paper introduces the Volumetric Video (VV) Editor, an innovative software tool designed for trainers to create immersive training experiences utilizing Volumetric Videos. These enable an immersive three-dimensional representation of an object or scene through point cloud visualization. Additionally, their creation is less time-consuming and, therefore, more cost-effective as it requires less expertise compared to the creation of animated 3D meshes of the same object or scene. The VV Editor is one of three applications that together form a larger pipeline that makes it possible to create immersive training content based on Volumetric Videos. It allows trainers to effectively edit video content and enhance it with additional spatial information, thereby ensuring a meaningful training process in Extended Reality (XR) environments. To validate the initial version of the VV Editor a preliminary user study was conducted that showed promising results regarding user engagement and satisfaction while also highlighting possible areas of improvement.
VR01070 **17:00-17:15**	Title: TacMedVR: Immersive VR Training for Tactical Medicine—Evaluating Interaction and Stress Response Author(s): Volodymyr Tretyak, Eduard Gröller Presenter: Volodymyr Tretyak, TU Wien, Austria Abstract: Abstract—This paper presents the development and evaluation of a virtual reality (VR) training simulation for tactical emergency medicine, created in Unity and optimized for the Meta Quest 3 headset. The simulation places users in a high-stress scenario inspired by real knife attacks and incorporates natural hand tracking for interaction. Core training elements include triage, bleeding control, and communication with victims and bystanders. A qualitative study with ten participants, all with prior first aid or tactical medical training, explored three key research questions: (1) To what extent does the realistic recreation of real-world events affect trainees' perceived psychological stress and sense of immersion in virtual reality simulations? (2) How do hand tracking and traditional controllers compare in terms of usability? (3) How is VR perceived as a complementary or alternative method to conventional training? Thematic analysis

	revealed that visual and auditory realism enhanced immersion but did not consistently increase perceived stress. Hand tracking was considered intuitive but occasionally unreliable. Participants generally viewed VR as a valuable complement to traditional training, particularly for practicing workflows and rapid decision-making under pressure. The results underscore VR's potential as a scalable, engaging, and safe tool for preparing responders for high-threat environments. Index Terms—Interaction Design, Hand Training, Medical Simulation, Simulation-Based Training
VR2042 **17:15-17:30**	Title: Interactive AR-Based 3D Geological Visualization of Subsurface Mining Structures: Real-Time Performance Evaluation in the Jiaojia Gold Mine Author(s): Liang He, Jiayan Zhao, Klippel Alexander, Yuxuan Zhu, Luoxi Liu Presenter: Liang He, Nanjing Xiaozhuang University, China; Yuxuan Zhu, Nanjing Xiaozhuang University, China Abstract: To address the challenges of geological information visualization and interactive decision-making in underground mines, this study proposes and implements an innovative AR-based 3D visualization platform for underground gold mines. Traditional tools rely on static 2D drawings or CAD models, which cannot dynamically update geological information in real-time due to their static representation, lack of real-time data integration, and limited interaction efficiency. In the face of disasters like sudden water or mud bursts, these tools struggle to provide timely updates, leading to low efficiency in disaster management. To solve these issues, this paper discusses the design and implementation of a multi-device collaborative framework. The platform, named GeoLens AR Platform integrates HoloLens 2 and tablets for AR visualization, with the Jiaojia Gold Mine as the testbed. It combines real-time data fusion, multi-modal interaction (gestures, voice commands, and touch interfaces), and lightweight rendering. Experimental results demonstrate significant improvements in efficiency and accuracy, with a 30% reduction in task completion time compared to traditional CAD model management and a 95% accuracy in geological information recognition. This study demonstrates the potential of AR technology in the visualization of underground mining structures. Itprovides empirical assessment and technical solutions for the integration of intelligent mine construction and the industrial metaverse.
VR2048 **17:30-17:45**	Title: Developing MIRCON: A Mixed Reality Configurator to Determine User Requirements in Light Electric Vehicles Author(s): Mihov Ornella Presenter: Ornella Mihov, German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt, DLR), Germany Abstract: The use of light electric vehicles offers the potential to save resources, reduce emissions, and optimize urban space. Despite these advantages, such vehicles currently hold only a minor market share. Conducting user studies is essential to understand why this is the case and to identify potential requirements for such vehicles. However, due to the low popularity of vehicle class L7e, participants may struggle to articulate their needs. Mixed Reality helps by immersing users in a virtual environment, enabling them to experience the vehicle firsthand and give more intuitive feedback. Through a configurator, users can explore various options and features, enabling them to prioritize those most relevant to them. Additionally, a tracked physical seat allows users to gain a better sense of scale and positioning. This paper discusses the conception, implementation, and execution of user tests for MIRCON (Mixed Reality Configurator).

SPECIAL SESSION 2

- **Topic: Food XR – Immersive Technologies for Food and Nutrition Studies**
- **Time: 10:00-11:45, July 11, 2025 | UTC/GMT+2**
- **Place: Momentum 2+3, Omnia**
- **Session Chair: Prof. Alexander Klippel, Wageningen University & Research, The Netherlands**
- **VR02046, VR02053, VR02054, VR02088, VR02092, VR02095, VR02096**

VR02046 **10:00-10:15**	Title: Energy Density Selected in Immersive Virtual Reality Buffet Meals Is Associated with Both Energy Density Consumed and Energy Intake in Laboratory Meals Author(s): John Long, Paige Cunningham, Sara Maksi, Kathleen Keller, Charissa Cheah, Lee Boot, Alexander Klippel, Timothy Brick, Caitlyn Edwards, Barbara Rolls and Travis Masterson Presenter: Alexander Klippel, Wageningen University & Research, The Netherlands Abstract: Innovative methods are needed to understand associations between food selection and intake across different contexts. We explored whether the energy density (ED, kilocalories per gram) of meals selected in an immersive virtual reality (iVR) food buffet predicted the ED consumed and overall energy intake in measured laboratory meals. In a secondary analysis, 91 adults (64 female, aged 18 to 71 years) selected foods for a meal in our iVR buffet before consuming a standard laboratory meal once a week for two weeks. The iVR buffet contained 30 foods varying in ED, ranging from 0.3 to 4.9 kcal per gram, including entrees, sides, soups, and desserts. The laboratory meals consisted of pasta, rolls, chicken, broccoli, grapes, and cookies, with ED values ranging from 0.4 to 4.8 kcal per gram. Linear mixed-effect models were used to examine associations between food selections in iVR meals and intake in laboratory meals. We found that the ED selected in iVR significantly predicted the ED consumed in laboratory meals. The ED consumed in laboratory meals and the ED selected in iVR meals were both positively associated with energy intake in laboratory meals. In addition, the carbohydrates, fats, and protein selected in iVR meals were each significantly associated with their respective intake in laboratory meals. The significant associations between food selections in iVR meals and intake in laboratory meals demonstrate the predictive validity of iVR. These findings highlight the utility of iVR as an innovative method to assess association
VR02053 **10:15-10:30**	Title: SMART-EAT: Towards Sustainable Nutrition Education and Decision Support using XR Author(s): Dennis Wüppelmann, Sarah Claudia Krings and Enes Yigitbas Presenter: Dennis Wüppelmann, Paderborn University, Germany Abstract: The food choices we make have a significant impact on the environment, biodiversity, climate, and our health. Typically, poor diets pose a major challenge, particularly for children and adolescents, as unhealthy habits formed during this period can have lasting effects on long-term health. With this paper we introduce the SMART-EAT project and its goals as well as the initial results after our first project phase. The SMART-EAT project aims to utilize immersive technologies, such as Virtual Reality and Augmented Reality, to provide personalized nutrition education and decision support. By employing an immersive learning approach, the project seeks to promote healthy and sustainable eating patterns, fostering nutritional competence among young people. A key aspect involves a low-code development approach to empower educators and learners to create their own interactive nutritional learning scenarios. We identified key requirements and criteria for these tools, including ease of use, customizations, and integration with immersive technologies. Our analysis highlights the need for a novel, intuitive, and end-user-friendly tool. Additionally, we introduce an example VR scenario for personalized nutrition education and decision support, demonstrating the potential of immersive learning for secondary school students. The project's future research includes developing interaction and collaboration concepts, creating a toolbox of VR/AR authoring

	tools, and conducting evaluations.
VR02054 **10:30-10:45**	Title: Portion Size Estimation Performance when Using Resizable Visual Aids of Matching Shape and Type in Virtual Reality Author(s): Nina Rosa, Michelle van Alst, Els Siebelink, Esther Kok, Jan Oliver Wallgrün, Travis Masterson and Alexander Klippel Presenter: Nina Rosa, Wageningen University and Research, The Netherlands Abstract: In nutrition research, measuring dietary intake is an important step in gaining insight into how diet contributes to the prevalence of non-communicable diseases. It is crucial to estimate portion sizes accurately, but most people find this difficult. Methods based on providing 3D virtual visual aids in, for example, augmented reality (AR) have been developed to improve estimation accuracy, but it is unclear how to design applications in order to improve accuracy, for example, whether the visual aid should be a realistic solid food replica or a more basic geometric shape. In this paper, we provide highly-needed basic research insights: we compared the performance of two common visual aid approaches and of free estimation in virtual reality, to better understand human portion size estimation and determine which approach shows more potential for portion size estimation in AR. The results showed that using realistic resizable virtual food replicas resulted in greater performance in terms of accuracy and precision than when using a basic cube wireframe and when using free estimation. Future research on visual aids should look into further potential benefits of using resizable aids of equal shape and type.
VR02088 **10:45-11:00**	Title: Blending Physical and Augmented Dining: Exploring Social Acceptability in Mixed Reality Restaurant Experiences Author(s): Campanini Maria Luisa, Costalunga Francesco, Bettelli Alice, Mingardi Michele, Orso Valeria, Gamberini Luciano Presenter: Maria Luisa Campanini, Department of General Psychology, University of Padova, Italy Abstract: Dining is a multisensory experience that is often shared with others and done in public places, e.g., restaurants. As such, it is characterized by interactions with both tablemates and the specific social norms of the venue where it occurs. The recent introduction of eXtended Reality (XR) technologies in this context, mainly through Head-Mounted Displays (HMDs), offers new opportunities for engagement while raising questions about their social appropriateness in public settings. This study explores the social acceptability of a Mixed Reality (MR) dining experience during a university-hosted public event. Twenty-four participants engaged in an immersive dining experience in an MR-based Restaurant using the Meta Quest 3 headset. Postexperience questionnaires assessed the perceived appropriateness of eating in public while wearing the device, feelings of isolation, openness to communication, comfort, enjoyment, privacy, satisfaction, willingness to recommend the experience, and willingness to use the HMD across different locations and with various audiences. Participants showed a positive attitude toward the MR dining experience and expressed openness to engaging in similar experiences across different scenarios. These findings highlight the feasibility of using MR in real-world dining contexts, opening new perspectives for the integration of immersive technologies in socially shared experiences.
VR02092 **11:00-11:15**	Title: A Virtual Reality Experience on the Relation between Biodiversity and Local Wheat Farming Methods Author(s): Liam Dwyer, Nina Rosa, Orkun Tekeli, Thomas Ginn, Alexander Klippel, Anke Janssen, René de Wijk Presenter: Liam Dwyer, Wageningen Social & Economic Research, The Netherlands Abstract: Virtual reality (VR) has been used to communicate many environmental sustainability and climate change issues. Biodiversity is a topic that lends itself well to various features of VR, such as creating immersive multisensory experiences, yet very few studies focus on biodiversity specifically. Moreover, in these few studies the goal is typically to create awareness, educate or change behavior in relation to natural areas rather than, for example, local farming landscapes. In this paper, we present two immersive VR environments focusing on local biodiversity-supportive versus

	biodiversity-unsupportive wheat farming. We reason why specific elements were chosen in the context of realistic biodiversity and landscape depiction, and discuss lessons learned from initial designs. We also present the integration of these immersive wheat fields into consumer journeys on wheat farming, bread production, selection and tasting. Lastly, we describe the design of an experiment planned based on these environments.
VR02095 **11:15-11:30**	Title: Taste Through a Different Lens: The Role of Mixed Reality Color Saturation in Sensory and Hedonic Evaluations Author(s): Francesco Costalunga, Alice Bettelli, Maria Luisa Campanini, Michele Mingardi, Valeria Orso, Luciano Gamberini Presenter: Francesco Costalunga, University of Padova, Padova, Italy Abstract: Visual perception significantly shapes food experiences, influencing taste expectations and sensory evaluation. While the impact of color on taste is well established, so far few studies have examined how specific visual manipulations in physical dining environments affect perception. This pilot study explores the relationship between visual manipulations of food appearance (i.e., color saturation) in Mixed Reality (MR) environments and taste perceptions. Twelve participants engaged in a MR dining experience where they consumed real food while experiencing controlled variations in color saturation. The study compared responses to sweet and savory stimuli under high and low saturation conditions. Participants provided ratings for both sensory attributes (sweetness, saltiness, sourness, bitterness, umami, and intensity) and hedonic attributes (goodness, freshness, naturalness, healthiness, quality, and perceived cost) both prior to and following tasting. Preliminary results suggest that color saturation may influence pre-consumption expectations and possibly affect post-consumption sensory evaluations for both taste and hedonic dimensions. Descriptive trends suggest differential effects based on the food stimulus. Despite preliminary, this study offers methodological insights for future investigations into crossmodal sensory integration and highlights the potential of MR as a tool for examining the complex interplay between visual context and taste perception.
VR02096 **11:30-11:45**	Title: Recognizing Food Neophobia Through Consumer Behavior in Virtual Reality Author(s): Jiayan Zhao, Jiaxin Wang, Jan Oliver Wallgrün, Rachelle de-Vries, Alexander Klippel Presenter: Jiayan Zhao, Wageningen University & Research, the Netherlands Abstract: Characteristics of individuals can influence eating behavior and food choices. Traditionally, scientists have assessed such characteristics through questionnaires and interviews. Explicit measures such as self-reports can be biased, however, by elements of social desirability and awareness of experimental aims or procedures. To address these shortcomings, this study uses implicit data exploring the use of virtual reality (VR) and machine learning to infer food-related personality traits from behavioral data. Specifically, we investigated whether food neophobia, or the reluctance to try unfamiliar foods, can be predicted based on eye- and body movements recorded during VR experiences. Participants (n = 42) completed a food selection task in a virtual buffet, after which four supervised machine learning models were developed using features derived from body-based translation, rotation, and eye-tracking data to classify participants into low and high food neophobia groups. These models were trained and cross-validated using participants' responses to the self-reported Food Neophobia Scale. The results show that the Random Forest model achieved the best performance, with a classification accuracy of 0.89 and Cohen's Kappa of 0.78 on the test set. While statistical analyses revealed significant differences in eye-tracking patterns between low- and high-neophobia groups when viewing familiar versus unfamiliar food items, body movement features contributed more strongly to overall model performance. Despite the small sample size, which limits the generalizability of the findings, this study shows the promise of combining VR, behavioral tracking (implicit data), and machine learning to support efficient, unobtrusive consumer profiling in food-related contexts and beyond.

ONSITE SESSION B

- **Topic: AI based Virtual Simulation and Virtual Device Development**
- **Time: 13:30-15:15, July 11, 2025 | UTC/GMT+2**
- **Place: Momentum 2+3, Omnia**
- **Session Chair: Assoc. Prof. Andrés Trujillo-León, Universidad de Málaga, Spain**
- **VR1005, VR1020, VR2040, VR2045, VR3066, VR3083, VR4105**

VR1005 **13:30-13:45**	Title: The Influence of Face and Gaze Tracking in HMDs on the Social Perception of Avatars Author(s): Matthias Wölfel, Daniel Hepperle, Jonas Deuchler and Michael Florath Presenter: Daniel Hepperle, Karlsruhe University of Applied Sciences and University of Hohenheim, Germany Abstract: The advent of head-mounted displays and sensors that track various bodily characteristics, including gaze and facial expression, has made it possible to create highly realistic virtual representations and movements of people's faces and bodies, resulting in lifelike avatars. While some users within the same social virtual reality application may utilize advanced devices to track and replicate a multitude of subtle bodily movements and expressions, other users may lack access to sophisticated tracking technology for various reasons. In the context of avatar-mediated communication, this technological disparity has the potential to influence how avatars are perceived by others. To investigate whether notable discrepancies exist in the social perception of avatars among interlocutors, a crossover design was employed with 32 participants exposed to one identical representation of an avatar with the following two variations: one shows gaze and facial expressions according to the tracked features in the headset, the other exhibiting pseudo-random gaze and facial movements. The findings indicate that tracking significantly enhanced the avatar's perceived social characteristics humanlikeness and likability while expertise is not influenced
VR1020 **13:45-14:00**	Title: A Comparative Analysis of 5G and WiFi6 for VR Immersive Education Author(s): Khalid Aljohani, Burak Kizilkaya, Sajjad Hussain, Qammer H. Abbasi, Muhammad Ali Imran and Shuja Ansari, Presenter: Khalid Aljohani , University of Glasgow Abstract: The adoption of Virtual Reality (VR) in education is rapidly evolving, driven by the need for immersive, real-time, and interactive learning experiences. However, the performance of VR-based learning environments is highly dependent on network connectivity, with key parameters such as round trip time (RTT), packet loss, jitter, and frames per second (FPS), influencing user experience. In this paper, we conduct a comparative analysis of Private 5G (P5G) and WiFi6 for VR-based education, examining the impact of different network configurations. Experimental results indicate that P5G consistently delivers, near-zero packet loss, and minimal jitter, making it the most reliable option for immersive learning. While WiFi6 maintains a steady latency and FPS, its performance degrades under higher network loads due to increased packet loss and jitter, which may introduce inconsistencies in VR experiences. On the other hand, our experiments on built-in 5G modules and external 5G dongles reveals that while the external dongles performs well, they exhibit variability in round trip time and packet loss under increased device densities, highlighting limitations of external 5G modules. These findings provide insights on the critical role of different connectivity and networks on seamless VR education.
VR2040 **14:00-14:15**	Title: Reviving Ancient Ephesus: An AI-Powered Virtual Realm Author(s): Ahmet Denker, Arda Yurt, Ayberk Gormus, Can Mert Piker, Eray Gunduz Presenter: Eray Gunduz, Istanbul Bilgi University, Turkey Abstract: The rise of artificial intelligence (AI) has ushered in a new era of interactive experiences of virtual antiquity, where virtual characters play a central role in engaging visitors at reconstructed cultural heritage (CH) sites. This study explores the intersection

	of Virtual Reality (VR) and AI-driven character creation in enriching the virtual experience of ancient Ephesus at its peak. By integrating lifelike AI-powered avatars, imbued with personality and emotion, we try to showcase that it is possible to bridge the gap between visitors and digital heritage environments. These intelligent avatars, driven by sophisticated AI technologies serve as interactive guides, fostering immersive and intuitive engagement. They not only respond to user interactions but also adapt their behavior dynamically, enabling deeper, more personalized storytelling experiences. At the core of this innovation is the synergy between AI technologies such as Natural Language Processing (NLP) and machine learning, which empower avatars to comprehend and generate human-like responses, recognize emotions, and react in real time. This transformative approach enhances user engagement by offering interactive narratives that bring the history of ancient Ephesus to life. Beyond technical implementation, effective character design plays a crucial role in audience immersion. Our approach incorporates creation of life-like avatars and storytelling principles, ensuring that avatars possess distinct personalities, motivations, and rich backstories that resonate emotionally with users. Through expressive dialogue, gestures, and nuanced interactions, these AI- driven characters transcend traditional virtual experiences, creating a compelling, memorable journey through the streets of ancient Ephesus. This work demonstrates the potential of AI- driven avatars in digital heritage applications, offering a glimpse into the future of cultural and historical heritage where historical reconstructions become not just visual representations, but living, interactive worlds.
VR2045 **14:15-14:30**	Title: A Journey into Ancient Pergamon: A Virtual Experience with AI Integration Author(s): Ahmet Denker, Mert Mengilli, Kaan Gökdere Presenter: Mert Mengilli, Istanbul Bilgi University, Turkey Abstract: This paper presents a comprehensive exploration of the ancient city of Pergamon through the integration of Virtual Reality (VR) and Artificial Intelligence (AI). By developing lifelike avatars modeled after historical depictions of ancient Pergamenese, the project enhances user interaction and immersion within a digitally reconstructed cityscape. Utilizing advanced 3D modeling, VR, and AI technologies, the ancient city of Pergamon is revived, allowing users to experience its cultural and architectural grandeur during the Hellenistic period. AI-powered avatars traverse the virtual city, offering historical narratives and contextual information about significant landmarks, thereby bridging the gap between historical scholarship and interactive edutainment. This dynamic interaction serves as a novel educational approach to preserving and disseminating cultural heritage. By synthesizing historical research with state-of-the-art digital tools, the proposed framework underscores the potential of VR and AI in creating immersive historical experiences that engage contemporary audiences while preserving the cultural legacy of ancient civilizations.
VR3066 **14:30-14:45**	Title: Haptic Cushion for Conveying Navigation Cues Author(s): Ana Álvarez-Crespo, Rafael Villalba-Bravo, Byron Remache-Vinueza, Fernando Vidal-Verdú, Andrés Trujillo-León Presenter: Andrés Trujillo-León, Universidad de Málaga, Spain Abstract: The number of devices that provide information through haptic feedback keeps growing due to their applications in biomedicine, industry, or entertainment. This paper presents a haptic cushion that conveys navigation cues to the user seated atop it. The device comprises an MDF base equipped with actuators and covered with a commercial cushion. The generation of different cues is achieved through tactile illusions of motion, which allow the use of fewer actuators while creating smooth motion perceptions. Two experiments were conducted to evaluate the device. In the first one, volunteers were tasked with identifying the motion cue conveyed by the cushion from five given options. The results indicated that most participants could differentiate the motion patterns with a reasonable degree of confidence. The second experiment assessed the haptic cushion as a tool to provide motion commands in a navigation task, namely a treasure hunt game. Participants were instructed to navigate a map of squares, following the trajectory indicated by the cushion. Almost 70% of them demonstrated a perfect performance, with 16% exhibiting a single error and 8% committing two errors. The results appear to

	support the proposal's viability.
VR3083 **14:45-15:00**	Title: Face Off: Evaluating Virtual Human Expressions and Non-Tracking Control Methods in VR Author(s): Sangeeth Chandran J K, Marisa Llorens Salvador, Cathy Ennis Presenter: Sangeeth Chandran, TU Dublin, Ireland Abstract: Social virtual reality (VR) applications have become more ubiquitous in recent years; central to this is the communica- tion pipeline, how users perceive virtual human facial expressions, and how they control them in real time, especially when using VR devices without face-tracking. We investigated both aspects in a set of experiments. Firstly, we compared the perception of virtual human emotions on a traditional 2D screen and in VR. In a second experiment, we used a validated set of stimuli to compare three different control methods for manipulating an avatar's facial expressions in VR. These control methods utilize non-tracking control techniques, which do not rely on real-time face tracking but rely on alternative inputs via the VR controller. Our analysis shows that in VR, the effectiveness ratings for happy, sad, and surprise were significantly higher, and disgust was significantly more recognizable, compared to the screen. These findings contribute to our understanding of virtual human based emotional communication in VR by demonstrating that the perception of facial expression varies between screen and VR. Additionally, we identify raycast selection (point and click) as the most accurate control method, whereas thumbstick labeled (using a controller thumbstick with UI labels for guidance) was the fastest and most preferred method by participants.
VR4105 **15:00-15:15**	Title: Towards Rhino-AR: A System for Real-Time 3D Human Pose Estimation and Volumetric Scene Integration on Embedded AR Headsets Author(s): Leif Van Holland, Ninian Kaspers, Nils Dengler, Patrick Stotko, Maren Bennewitz, Reinhard Klein Presenter: Leif Van Holland, University of Bonn, Germany Abstract: Real-time understanding of dynamic human presence is crucial for immersive Augmented Reality (AR), yet challenging on resource-constrained Head-Mounted Displays (HMDs). This paper introduces Rhino-AR, a pipeline for on-device 3D human pose estimation and dynamic scene integration for commercial AR headsets like the Magic Leap 2. Our system processes RGB and sparse depth data, first detecting 2D keypoints, then robustly lifting them to 3D. Beyond pose estimation, we reconstruct a coarse anatomical model of the human body, tightly coupled with the estimated skeleton. This volumetric proxy for dynamic human geometry is then integrated with the HMD's static environment mesh by actively removing human-generated artifacts. This integration is crucial, enabling physically plausible interactions between virtual entities and real users, supporting real-time collision detection, and ensuring correct occlusion handling where virtual content respects real-world spatial dynamics. Implemented entirely on the Magic Leap 2, our method achieves low-latency pose updates (under 40 ms) and full 3D lifting (under 60 ms). Comparative evaluation against the RTMW3D-x baseline shows a Procrustes-Aligned Mean Per Joint Position Error below 140 mm, with absolute depth placement validated using an external Azure Kinect sensor. Rhino-AR demonstrates the feasibility of robust, real-time human-aware perception on mobile AR platforms, enabling new classes of interactive, spatially-aware applications without external computation.

ONSITE SESSION C

- **Topic: Multi Sensory based Virtual Reality and Simulation Technology**
- **Time: 15:45-17:15, July 11, 2025 | UTC/GMT+2**
- **Place: Momentum 2+3, Omnia**
- **Session Chair: Prof. Edward Huijbens, Wageningen University & Research, Netherlands**
- **VR1002, VR1009, VR1012, VR1018, VR2036, VR3087**

VR1002 **15:45-16:00**	Title: AsymmetricVR, shared embodiment and group size: a pilot study about the New York City serious game for English practice Author(s): Mira Hajj Hassan, Rawad Chaker , Nady Hoyek Presenter: Mira HAJJ-HASSAN, Speedernet, France Abstract: This paper presents a pilot study on the use of a virtual reality tool designed to support asymmetric VR, where one user (the VR user) is immersed in the virtual environment, while the other (non-VR user) interacts with them from the external world. The study is conducted in the context of English-speaking exercises for adults. It aimed to test the application before its integration into actual language class materials. Participants engaged in a series of activities within a VR environment and worked collaboratively to solve language-based enigmas across four different tasks. A total of 17 participants grouped into 5 different size groups were involved in the pilot study, which provided valuable insights into the tool's hedonic and pragmatic qualities (AttrakDiff2 questionnaire), group dynamics and the effectiveness of collaboration. Promising results were found regarding user experience and the potential educational value of the tool. Future research should aim to refine the application's usability, validate findings with larger and more diverse samples. Additionally, future studies should test these user functionalities in other domains, such as sciences, technology, engineering, and mathematics, and investigate additional user experience dimensions, including age-related differences and accessibility improvements.
VR1009 **16:00-16:15**	Title: Investigating Tilt-Based Technique for Performing Wrist Movement Analysis in Virtual Reality Author(s): Ummi Khaira Latif, Zhengya Gong, Vijayakumar Nanjappan, Georgi V. Georgiev Presenter: Ummi Khaira Latif, University of Oulu, Finland Abstract: This paper explores a tilt-based technique for wrist movement analysis using 3D joint position data captured by a standard virtual reality (VR) controller device. This technique leverages natural tilt movements detected by VR controllers, offering a more streamlined and computationally efficient alternative to traditional methods that rely on complex sensor arrays or advanced machine learning models. We conducted a user experiment to evaluate the tilt-based technique in two key areas: movement recognition and kinematic metric measurement. First, we analyzed movement data to precisely recognize six distinct wrist movements, achieving a high F1 score of 93.8%. Next, we assessed the ability of the technique to measure kinematic metrics, specifically focusing on speed and smoothness. Our results showed that particular performance metrics aligned closely with the natural characteristics of the movements.
VR1012 **16:15-16:30**	Title: Interaction and Collaborative Intergroup Dynamics in Social Virtual Reality (SVR) Author(s): Timor Schwartz Miler, Nili Steinfeld Presenter: Timor Schwartz Miler, School of Communication Ariel University Abstract: This study explores intergroup interaction within immersive Social Virtual Reality (SVR) environments, focusing on the dynamics between majority and minority groups and the ways immersive settings shape social behaviors. Unlike previous research in the field of intergroup relations, that often examines non-immersive virtual platforms or face-to-face encounters, this study uniquely investigates multi-user interactions in fully immersive SVR, investigating the role of spatial proximity, avatar representation, and

	technological adaptation in an intergroup contact experience. Utilizing a mixed-methods approach, the research examines shifts in diversity attitudes, perception of social proximity, and interaction quality among culturally diverse participants, including majority and minority groups within the Israeli context. The findings highlight SVR's dual role as both a facilitator of meaningful intergroup engagement and a space where existing social dynamics and power imbalances persist. By uncovering how immersive virtual environments can simultaneously bridge and reinforce social divides, this study advances intergroup contact theory and offers actionable insights for designing equitable and culturally sensitive SVR spaces that promote dialogue, inclusion, and collaboration.
VR1018 **16:30-16:45**	Title: Virtual Reality-Based Laboratory Education: A Case Study in Microbiology Author(s): Seyedehfaezeh Mousavian Parsa, William Hurst, Bedir Tekinerdogan, Majid Zare Bidaki, Dick de Ridder Presenter: Seyedehfaezeh Mousavian Parsa, Wageningen, Netherlands Abstract: Virtual reality (VR) in education involves creating simulated interactive environments in which students learn concepts through hands-on experience and immersion. Using VR for simulation-based training caters to learning in an engaging manner without physical limitations. Virtual laboratories are considered one of the most promising applications of VR in education. In a virtual laboratory, students become practically familiar with specialized concepts and processes without the need for real equipment and with reduced risks. Although using technologies such as VR plays a significant role in science education, limited research has examined students' familiarity with this technology and its impact on learning. This study aimed to assess students' awareness of virtual laboratories, explore their views on the effectiveness of 3D interactive environments, and analyse their willingness to use these technologies in microbiology education. The findings showed that 83% of students rated 3D environments as engaging and interactive in education. Also, the result shows that 92% of students preferred a combination of traditional and virtual methods, indicating the complementary role of the two methods in education.
VR2036 **16:45-17:00**	Title: Evaluating human sense of presence in in-situ VR footbridge simulator Author(s): Bintian Lin, Rajesh Govindan, Stana Zivanovic Presenter: Bintian Lin, University of Warwick, UK Abstract: Virtual reality has been increasingly used in architecture, engineering, and construction to enhance design and human experience. While audio and visual advancements have progressed rapidly, realistic multisensory integration is essential for accurate assessment of built environments. This study presents a virtual reality simulator that replicates the testbed Warwick Footbridge in situ. For validation, the physical footbridge was modelled in Unreal Engine and displayed via a Quest 2 headset. Real-time displacement data of the footbridge, collected using a linear variable differential transformer, were utilised to simulate the bridge vibration movement in the virtual reality environment. Two test subjects performed tasks, including turning and walking across the bridge, to assess their sense of presence. Subjective feedback was collected using the Igroup Presence Questionnaire, with ratings compared against qualitative scales. Results showed that while average scores for spatial presence, involvement, and realism were marginally acceptable, the overall sense of presence was rated as acceptable, with one subject reporting it as satisfactory and the other as excellent. This study verifies the virtual reality-based simulator as a novel platform for assessing human sensations on footbridges.
VR3087 **17:00-17:15**	Title: Creating a Mixed Reality (Physical) Sandbox Author(s): Anusha Devanga, Vageesh Ramesh, and Ryan Bockmon Presenter: Ryan Bockmon, Northeastern University, United States Abstract: This paper presents the design, development, and evaluation of a mixed-reality sandbox system for creating educa- tional experiences in geoscience. It uses an Intel RealSense depth camera to capture real-time data from a portable sandbox, which is then visualized as a dynamic 3D terrain using Unity. Custom shaders were used in projecting the terrain back onto the physical sandbox, providing immediate visual feedback. Additionally, a VR experience was developed, allowing users to explore the terrain they

	shaped in an immersive environment. A user study was conducted to assess usability and engagement; participants responded positively, particularly to the water simulation effects. Feedback suggested enhancing realism further by adding more environmental textures.

ONLINE SESSION 1

- **Topic: Virtual Reality and Immersive Experience based on Vision**
- **Time: 09:30-11:45, July 11, 2025 | UTC/GMT+2**
- **Zoom: https://us02web.zoom.us/j/83792200883 password: ICVR**
- **Session Chair: Assoc. Prof. Xiangdong Li, Zhejiang University, China**
- **VR01010, VR01017, VR01072, VR01075, VR1014, VR1019, VR1026, VR2043, VR3079**

VR01010 **9:30-9:45**	Title: Enhancing Student Well-Being: Virtual Reality for Coping with Exam Stress Author(s): Iñigo Cuiñas, Itziar Goicoechea-Castaño, María del Pino Díaz-Pereira, Joseba Delgado-Parada, Dorota Kamińska and Grzegorz Zwoliński Presenter: Iñigo Cuiñas, Universidade de Vigo, Spain Abstract: University students frequently experience high levels of stress, particularly during assessment situations such as exams and oral presentations. This study explores the development of a virtual reality (VR) tool for coping with and regulating stress in assessment situations. The approach integrates immersive VR experiences with thoughtfully designed physical environments to provide a comprehensive stress-relief solution. The development process included an initial diagnostic phase aimed at identifying students' preferences for facilitating environments and activities for emotional regulation. A second phase focused on the design of VR scenarios and tools that integrated natural environments, guided relaxation techniques and interactive elements. The last phase implies usability studies and physiological measurements that objectively validated the tools' effectiveness, while self-reported stress levels provided additional subjective insights. Iterative improvements based on user feedback further enhanced the application's realism and interactivity. Users reported weaknesses that allowed for improvements related to the level of realism and interactivity of the application. The effectiveness of the tool was confirmed through measurements of a physiological nature, as well as through subjective measures obtained through a validated questionnaire. The findings indicate that VR-based interventions can be useful in promoting emotional competencies in students that are conducive to emotional well-being and mental health.
VR01017 **9:45-10:00**	Title: Immersive Learning in Virtual Reality: Soft Skills Training with eXcape Author(s): Belma Ramic-Brkic, Agnieszka Dubiel, Bojan Mijatovic, Massimo Zancanaro Presenter: Agnieszka Ewa Dubiel, Lodz University of Technology, Poland Abstract: Virtual Reality (VR) is increasingly recognized as a transformative tool for soft skills training, offering immersive and interactive environments that enhance learning outcomes. The eXcape project leverages VR to develop realistic scenarios that can be designed to practice and learn critical soft skills, such as communication, teamwork, problem-solving, adaptability, and leadership. This paper presents a systematic approach to designing these scenarios ensuring effective skill acquisition and transferability. We discuss the methodology employed in scenario creation, key pedagogical considerations, and the challenges encountered in designing immersive training experiences.
VR01072 **10:00-10:15**	Title: Understanding Student Attention in Virtual Reality Learning Environments Through Eye-Tracking Author(s): Melody Han, Iris Qian and Daniel Doe Presenter: Daniel Doe, Prairie View A&M University, USA Abstract: This study investigates how statistical analysis of eye-tracking data in virtual reality (VR) classrooms can reveal student attention patterns and inform strategies to enhance educational outcomes. By analyzing gaze patterns and transitions through computational techniques grounded in statistical modeling and informed by machine learning, we assess students' attention distribution and engagement throughout a VR-based lecture. Our research addresses six key questions: (1) how gender influences attention allocation, (2) the relationship between off-screen focus and overall screen

	attention, (3) whether attention across objects deviates from random distribution, (4) which objects act as frequent attention attractors, (5) how attention patterns shift over time, and (6) whether non-screen focus predicts attention loss. Using statistical techniques inspired by machine learning approaches, we identify a clear hierarchy of attention, with students primarily focusing on the screen, followed by the floor, walls, and table. We observe dynamic attention-switching behaviors, analyze engagement with virtual advertisements, and uncover gender-specific patterns in visual focus. These findings have practical implications for designing more effective and inclusive VR classrooms, including strategic placement of instructional content and adaptive layout based on individual attention profiles. This research contributes to the optimization of immersive educational environments by offering data-driven insights into student engagement and attention dynamics.
VR01075 **10:15-10:30**	Title: KovilLens: A Mixed Reality Application for Digital Preservation and Exploration of Moovar Kovil Author(s): Purushottam Reddy Chinthakuntla, Uma Gopalakrishnan, Ramkumar N, Balaji Hariharan Presenter: Uma Gopalakrishnan, Center for Wireless Networks & Applications (WNA), Amrita Vishwa Vidyapeetham, Amritapuri, India Abstract: India's rich architectural heritage, exemplified by majestic temples and monuments, is a testament to its cultural and artistic legacy. Digital preservation emerges as a crucial tool to safeguard this heritage from getting lost over time. This paper presents a case study on preserving India's rich architectural heritage using mixed reality (MR) technology. We focus on Moovar Kovil, a 9th century Chola temple complex in Tamil Nadu. By leveraging Microsoft HoloLens 2, we have developed a MR application, "KovilLens", that digitally reconstructs and restores the now dilapidated temple, allowing users to experience it in its pristine state. KovilLens offers two modes: a guided storytelling mode, which provides an immersive historical and architectural narrative, and an interactive analysis mode, where users can freely explore the virtual temple, examining intricate details and witnessing its simulated destruction and reconstruction. KovilLens's immersive, visually realistic mixed reality experience of Moovar Kovil garnered overwhelmingly positive feedback from both casual temple visitors and historians. This MR application not only provides an engaging educational tool for students and history enthusiasts but also serves as a valuable tool for heritage preservation.
VR1014 **10:30-10:45**	Title: A Billiards Learning Assistant System with Head-Mounted AR Author(s): Jintao Yan, Yinwei Zhan and Zhuo Yang Presenter: Jintao Yan, Guangdong University of Technology, China Abstract: Billiards is a sports with a high entry barrier, but traditional training methods lack intuitive visual guidance. This paper presents BiLAR, a billiards training system based on head-mounted augmented reality, utilizing HoloLens 2 to achieve precise overlay of virtual guidance information on the physical billiard table. BiLAR is able to recognize and locate balls on the table, automatically analyze current shot selections and cue ball control strategies, and display holographic ghost balls for aiming guidance with virtual User Interface(UI) elements indicating recommended cue ball control strategies. We utilize a pre-trained YOLO V8 model for ball detection and positioning and a pre-trained Fully Convolutional Neural Network(FCNN) for cue ball control strategy analysis. BiLAR can accomplish the entire process of detection, positioning, and strategy analysis within 2 seconds before each shot, with the HoloLens 2's limited computing power. Experiments with 7 participants on a real billiard table statistically validated that BiLAR is able to effectively guide players in aiming and executing proper cue ball control operations.
VR1019 **10:45-11:00**	Title: Motion ID: Gesture-Based Biometrics for User Identification and Authentication in Virtual Reality Author(s): Prithiv Premkumar, Ryan Clark, Ian Valderas, Gaurang Kamat, Bruce Walker Presenter: Prithiv Premkumar, Georgia Institute of Technology, USA Abstract: This study explores a novel approach to gesture-based biometrics for identifying and authenticating virtual reality (VR) users, focusing on methods beyond traditional

	task-based systems to improve real-world applicability. By employing a Random Forest model, the research assesses various gestures—such as hand waves, finger wiggles, and YMCA dance movements—analyzing accuracy across different VR headsets. These models are both able to identify which user out of a user group is using the headset from the motion data as well as authenticating them based on confidence levels. This cross-headset evaluation, using a sliding window technique with Euclidean distance for joint-based tracking, establishes a more reliable means of user authentication that surpasses prior studies in accuracy. By using shorter data segments (1–2.5 seconds) for identification, this approach enables faster and more practical authentication along with smaller training data segments for model creation. Results suggest that gesture biometrics could enhance fields such as multi-factor authentication and continuous biomarker tracking. This work contributes to existing VR biometrics literature by demonstrating that gesture-based biometrics can effectively authenticate users across diverse VR devices, potentially leading to more secure and user-friendly applications.
VR1026 **11:00-11:15**	Title: Psychophysiological Computational Modeling for Stress Management in VR Driving Simulation Author(s): Sai Raghu Ram Adivi, Yi Li, Md Majedul Islam and Jing He, Paper ID: VR1026 Paper Title Presenter: Md Majedul Islam, Kennesaw State University, USA Abstract: Stress detection and management are vital for enhancing individual well-being and ensuring safe driving in high-pressure environments. In this study, we investigate the use of physiological indicators—specifically electrodermal activity (EDA), heart rate variability (HRV), and body temperature—to assess stress levels during virtual reality (VR) driving simulations. We propose a novel weighted aggregation approach that integrates refined metrics for EDA, HRV, and temperature-related stress factors, offering a comprehensive method for stress evaluation. While conventional machine learning (ML) and deep learning (DL) models are employed as analytical tools to support our framework, our primary contribution lies in establishing a robust methodology for stress detection. This work not only deepens the understanding of the complex interplay between physiological responses and stress but also lays a foundation for future research into adaptive stress management strategies and real-time monitoring solutions.
VR2043 **11:15-11:30**	Title: Like To Move: A Novel Dual-Mode One-Handed Locomotion Technique for Virtual Reality Author(s): Matteo Basile, Marco Raoul Marini, Luigi Cinque Presenter: Matteo Basile, Sapienza University of Rome, Italy Abstract: Locomotion in virtual reality remains a significant challenge for researchers and developers. The main issue arises from the inconsistency between the expansive virtual environments and the often limited, obstacle-filled physical spaces available to users, which can raise safety concerns. This paper introduces a novel one-handed locomotion technique that can be used while sitting or standing, utilizing the left hand as a controller for both movement and rotation through a simple gesture. The method is compared with two other one-handed locomotion techniques used while standing, focusing on usability, workload, comfort, and the feeling of sickness, all tested on a designed obstacle course, according to scientifically consistent comparative metrics.
VR3079 **11:30-11:45**	Title: Design Fundamentals that Elicit Emotions in Contextual Virtual Reality (VR) Environments Author(s): Harshit Kumar Gupta, Aishvarya D, Kavan PH, Samruthi Shanmugam, Dr. Priyanka Bharti, Dr. Vinay Krishna Sharma, Govindaprasath Elangovan, Dr. Adithya Balasubramanyam Presenter: Samruthi Shanmugam, PES University, India Abstract: The rapid integration of Virtual Reality (VR) across multiple fields has highlighted the important role of design elements in enhancing user immersion and experience, through intuitive and engaging virtual environments. This study investigates how design elements—specifically shape, color, texture, and lighting—within virtual reality (VR) environments can be utilized to evoke targeted emotional responses: joy,

	sadness, fear, and anger. Grounded in Plutchik's Wheel of Emotions (1980), the research encompasses a comprehensive literature review, the development of 3D models using Blender, and the creation of immersive VR scenes in Unity. User experiences were assessed through VR headset interactions, employing the PANAS (Positive and Negative Affect Schedule) and SAM (Self-Assessment Manikin) scales for emotional evaluation. Findings aim to inform design guidelines that enable VR developers to intentionally craft environments eliciting specific emotional reactions, thereby enhancing user engagement and experience.

ONLINE SESSION 2

- **Topic: AI-driven Mixed Reality and Multimedia Application Technology**
- **Time: 13:00-15:15, July 11, 2025 | UTC/GMT+2**
- **Zoom: https://us02web.zoom.us/j/83792200883 password: ICVR**
- **Session Chair: Prof. Dorota Kamińska, Instytut Mechatroniki i Systemów Informatycznych Politechniki Łódzkiej, Poland**
- **VR1013, VR1015, VR1024, VR2032, VR2057, VR3063, VR3069, VR4101, VR4103**

VR1013 **13:00-13:15**	Title: ImoGenXR: Investigating the Impact on Creativity Support in a Generative-AI Assisted Immersive Authoring Workflow Author(s): George Limbert and Abhijit Karnik Presenter: George Limbert, Lancaster University, United Kingdom Abstract: Creating interactive extended reality experiences is currently a complex activity with a high entry barrier of developer skills. Immersive authoring and no/low code techniques are a promising direction towards democratizing access to novice users as they lower the entry barrier while users develop advanced skills. Similarly, generative-AI has shown potential for template code generation, 3D model creation and retrieval. In this paper, we present ImoGenXR, an immersive workflow integrated with Unity and scaffolded by existing generative-AI. Users can build scenes within the immersive environment by inserting 3D models using voice commands. They can also attach AI-generated code to invoke desired behaviours without leaving the immersive environment. We use ImoGenXR's workflow to explore the effect of creativity support using generative AI on an existing tool like Unity. The results show significant improvement in user experience for novice users. ImoGenXR shows the value of including creativity support through generative AI for existing XR development tools.
VR1015 **13:15-13:30**	Title: PanoMambaDepth: Self-supervised Omnidirectional Monocular Depth Estimation With Self-distilled Panoramic Mamba Network Author(s): Yang Xiao, Chuanqing Zhuang, Dongbo Yu, Lupeng Liu and Jun Xiao Presenter: Yang Xiao, University of Chinese Academy of Sciences, China Abstract: Panoramic depth estimation plays a pivotal role in critical applications such as autonomous navigation and immer-sive virtual reality. Supervised methods are fundamentally limited by the high cost of obtaining panoramic depth ground truth data, while the currently popular self supervised methods still have problems in efficient global context modeling and effective aggregation of global features, which in turn affects the accuracy of depth estimation. To address these limitations, we propose PanoMambaDepth, a novel self-supervised panoramic depth estimation network. First, we propose a bidirectional cross-scan mechanism for panoramic images to efficiently and accurately model global context information based on VMamba. Then, we design a feature aggregation module through the dynamic region division and attention mechanism, which effectively solves the distortion problem caused by the imbalance of information density of spherical images in the latitudinal direction. Finally, we adopt a multi-stage training strategy based on self-distilled designed for panoramic images. This strategy achieves reliable binocular depth estimation through feature matching based on panoramic depth-aware and further optimizes monocular depth estimation results via distillation. In this work, through a series of comparative and ablation experiments, we demonstrate the ef-fectiveness of PanoMambaDepth for panoramic depth estimation.
VR1024 **13:30-13:45**	Title: A framework for personalized cognitive involvement detection in virtual reality: proof-of-concept Author(s): Lucas Schöffer, Sophia B. Wanner, Adrian Vulpe-Grigorasi, Djordje Slijepčević, Andreas Elleby Jespersen, Anders Lumbye, Kamilla Woznica Miskowiak, Vanessa Leung Presenter: Lucas Schöffer, St. Pölten University of Applies Sciences, Institute of Creative Media Technologies, Austria

	Abstract: We present an approach for a standardized and extensible system that integrates multiple biosensors into virtual reality (VR) applications to enable personalized, user-adaptive experiences. Current VR training systems are typically linear and do not account for users' cognitive states, despite the growing availability of biosignals such as EEG, GSR, ECG, and eye tracking. VR training that adapts to individual user needs can improve effectiveness and outcomes. Our system is built on open technologies and uses the Lab Streaming Layer (LSL) to enable multimodal synchronized biosignal data. It incorporates a standardized procedure that includes a resting baseline phase, followed by desktop-based cognitive tasks and a structured VR application comprising cognitive challenges drawn from neuropsychological assessment protocols. These structured pretests are designed to track cognitive load variations and support the development of individualized user profiles. In a pilot study with 14 participants, we observed substantial inter-subject variability in biosignal responses—particularly EEG-derived cognitive workload indicators (e.g., theta/alpha ratio). These findings align with existing literature and underscore the limitations of generalized adaptation models. By offering a modular, open-source platform and methodology built around standardized cognitive assessment, our approach provides a foundation for constructing user-specific biomarker profiles and enables the creation of adaptive VR scenarios that dynamically respond to users' cognitive states.
VR2032 **13:45-14:00**	Title: AgroAR: An Augmented Reality-Based IoT System for Real-Time Plant Health Monitoring and Disease Detection in Greenhouses Author(s): Sandeep Kumar Reddy M, Vinod Kumar K, Y Vishnu Vardhan Reddy, Yadunand A, Prasad Honnavalli, Ashok Kumar Patil Presenter: Sandeep Kumar Reddy M, PES University Abstract: Agriculture requires precise, real-time solutions for plant health monitoring and disease detection, especially in controlled environments like greenhouses, where conditions are quite different from the ones in the open fields. Traditional methods fall short in providing timely insights as they are highly dependent on human expertise and prone to errors, leading to suboptimal crop management and reduced yields. AgroAR, is an augmented reality-based application designed to enhance plant monitoring and disease detection in greenhouse conditions. This project uses Augmented Reality, IOT Sensors and Cloud Computing concepts and integrates them to deliver a comprehensive solution that enables farmers to visualise and avail real time data like humidity, temperature, soil moisture from their local devices. This system incorporates deep learning algorithms like YOLOv7 for accurate disease detection and identification in rose plants, providing insights for effective crop management. Additionally, the application provides navigation to the disease infected plants, allowing for efficient intervention and resource allocation.
VR2057 **14:00-14:15**	Title: Immersive experiences for cognitive stimulation of patients in early stages of Alzheimer's disease Author(s): João Gonçalves, João Dias, Pamela Teubig Presenter: João Maria Crespo Gonçalves, IADE - Universidade Europeia Abstract: Therapeutic interventions aimed at cognitive stim- ulation and delaying the progression of Alzheimer's disease are possible in the early stages. Virtual reality (VR) has become a promising tool in this field, offering immersive and safe environments that can be adapted to patients' needs. This article presents a solution consisting of three games that take advantage of VR to stimulate cognitive functions in individuals in the early stages of the disease, such as memory, attention, and visual recognition. The proposed solution eliminates the need for physical controllers by employing hand-tracking capabilities of the headset itself, thus promoting greater accessibility and usability for seniors. Although still in a preliminary phase, this approach demonstrates potential as a cognitive rehabilitation tool, with prospects for evaluation in clinical settings and the development of personalized functionalities.
VR3063 **14:15-14:30**	Title: AC-Motion: High-Quality Arbitrary Motion Style Transfer with Local Channel Modulation and Adaptive Attention Author(s): Xinjie Chen, Yuan Ma, Meili Wang Presenter: Xinjie Chen, Northwest A&F University, China

	Abstract: Motion style transfer plays a crucial role in fields such as animation production and virtual reality. Although recent methods have shown promising results, they often struggle to maintain the structural integrity of content motion when adapting styles that involve motion bobbing behaviors such as jumping, resulting in distortions and unnatural stylized motions. To address these challenges, we propose AC-Motion, a framework comprising two core components: 1) an Adaptive Attention Network (AdaAtt-Net) that improves local feature representation through a lightweight channel-aware modulation prior to normalization and refines style-content integration via an adaptive attention mechanism; and 2) a Content Consistency Loss, a motion-specific constraint designed to align the stylized motion with the structural characteristics of the source, mitigating unintended body oscillations and subtle structural deviations during style transfer. By jointly leveraging adaptive feature modulation and structure-preserving constraints,AC-Motion generates more natural, accurate stylized motions while maintaining a streamlined architecture. Extensive experiments demonstrate the substantial improvements achieved by our approach across diverse motion style transfer tasks.
VR3069 **14:30-14:45**	Title: Assessing the Effectiveness of Immersive VR in Dragon Dance Learning: A Comparative Study with Image and Video Methods Author(s): Lei Zhang, Ran Li, Li Ning, Hao Jiang Presenter: Ran Li, University of Chinese Academy of Sciences, Institute of Computing Technology, China Abstract: Dragon dance is a traditional Chinese sport characterized by a series of dynamic and static movements such as undulating, rolling, leaping, coiling, and weaving, which together create highly three-dimensional and aesthetically expressive formations. Effective self-directed learning of these movements requires strong spatial awareness and precise motion execution. To evaluate the effectiveness of VR simulation-based learning for dragon dance, this study conducts a comparative experiment involving three instructional modalities: static image-based learning, standard video-based learning, and immersive VR simulation. Through experimental testing, quantitative analysis, and questionnaire-based evaluation, the study assesses learners' mastery of dragon dance formations. Results demonstrate that VR simulation offers clear advantages over traditional image and video-based methods, suggesting its potential to support and advance the broader development of dragon dance training.
VR4101 **14:45-15:00**	Title: Dual-Modal Feature Extraction Method for Bronze Ware Based on Image–Point Cloud Fusion Author(s): Wang Zepeng，Fang yujie，Yang Huijun,Zhang Zhiyi Presenter: Fang Yujie, Northwest A&F University, China Abstract: Point cloud feature extraction is a pivotal technology in 3D vision, holding great significance in fields such as the digital protection of cultural relics. To address the issue of incomplete feature extraction caused by occlusions and low-texture regions in complex scenes, this paper proposes a bimodal feature collaborative extraction method for bronze cultural relics based on multi-view data. This method integrates 2D image semantics and 3D geometric features to enhance the integrity and accuracy of feature extraction. Firstly, the point cloud is rotated at multiple angles, and spatial constraints are applied to generate multi-view point clouds, which are then projected onto the corresponding two-dimensional images. Secondly, the Canny algorithm is employed to extract the edge features of the two-dimensional projection images. Thirdly, the height difference and principal curvature ratio are utilized to extract the geometric features of the point cloud. Finally, the features of the images and point cloud are fused and mapped, and stable feature points are selected according to a custom strategy. Experimental results demonstrate that the proposed method can stably extract detailed features such as the surface ornaments and inscriptions of bronze artifacts. It is suitable for digital modeling and restoration research of cultural relics, effectively reducing the risk of damage to cultural relics caused by frequent on-site investigations and exhibitions. Index Terms—Multi-View Point Cloud, Feature Extraction, Multi-Modal, Bronze Ware

VR4103 **15:00-15:15**	Title: Visuo-Haptic VR Therapy: A Multisensory Framework Using AI-Generated Felt Plants for Stress Relief Author(s): Duocan Li, Xinrui Wang, Jianquan Liu, Mengjie Huang, Rui Yang Presenter: Duocan Li, Xi'an Jiaotong-Liverpool University, China Abstract: The rapid evolution of virtual reality (VR) offers significant potential for immersive stress relief. However, the role of artificial intelligence (AI)-generated visual elements in emotion regulation—particularly when integrated with dynamic haptic feedback—remains underexplored. To address this gap, we propose and evaluate a novel visuo-haptic VR therapy framework utilizing AI-generated felt-style plant scenes. Three progressive studies were conducted: (1) a survey (N=176) measuring acceptance and perceived calmness of AI-assisted painting with feltstyle; (2) a laboratory experiment (N=37) comparing affective responses to real versus AI-generated plants and perception of felt material with visuo-haptic conditions; (3) an immersive VR trial (N=15) assessing static, dynamic, and synchronized visuohaptic plant videos using subjective ratings and continuous skin conductance. Results show high acceptance of AI content, comparable pleasure for real and AI imagery, and markedly greater relaxation and restorative effects when visuals are coupled in real time with haptic feedback in VR. These findings demonstrate that AI-generated content, when dynamically fused with multisensory feedback, effectively enhances VR-based emotional well-being and provides a structured framework for virtual-scene therapy.

ONLINE SESSION 3

- **Topic: Innovative Application of Modern Virtual Technology in Information System**
- **Time: 15:45-18:00, July 11, 2025 | UTC/GMT+2**
- **Zoom: https://us02web.zoom.us/j/83792200883 password: ICVR**
- **Session Chair: Prof. Tilemachos Koliopoulos, Collaborator University of West Attica, Greece**
- **VR01099, VR1027, VR2049, VR2051, VR3068, VR3076, VR3077, VR3078, VR4104**

VR01099 **15:45-16:00**	Title: Low-Cost Digital-Twin VR Teleoperation of a 3D-Printed Robotic Arm for STEM Education Author(s): Jaime Gallego, Francesc Vallverdú Presenter: Jaime Gallego. Universitat Politècnica de Catalunya - BarcelonaTech (UPC), Spain Abstract: The integration of Virtual Reality (VR) with robotic systems offers opportunities for enhancing STEM (Science, Technology, Engineering, and Mathematics) education. This paper presents the design, implementation, and evaluation of a low-cost teleoperation system for a 3D-printed robotic arm, specifically tailored for educational applications. The system uniquely combines VR for intuitive control, a real-time digital twin for system visualization and understanding, and accessible open-source hardware. Utilizing a Meta Quest 2 headset, the Unity 3D engine, an Arduino MEGA 2560-based InMoov robotic arm, and a wireless communication architecture via an ESP32 module and UDP/IP, we demonstrate that this platform can be used for educational purposes. Experimental results validate the system's effectiveness in providing an engaging, hands-on platform for students to explore concepts in robotics, programming, kinematics, and cyber-physical systems with an average operational latency of $\sim$\SI{700}{\milli\second}. The complete robotic arm materials—excluding the assembly—can be reproduced for under €400, greatly lowering the barrier for adoption in resource-constrained classrooms. This work underscores the potential of affordable VR-robotic digital twin systems to democratize access to advanced technological learning experiences in STEM.
VR1027 **16:00-16:15**	Title: A Comparative Evaluation of 3D Gaussian Splatting and LiDAR for Digitizing Handheld Objects in VR Author(s): Oguz Orkun Doma; Yuanyuan Yin; Vanissa Wanick Presenter: Oguz Orkun Doma, University of Southampton, UK Abstract: This paper compares the effectiveness of mobile device-based LiDAR and 3D Gaussian Splatting for digitizing small objects for interactable use in immersive VR applications. The study aims to determine the most accurate and efficient consumer-accessible method for translating handheld real-world objects into immersive virtual environments using mobile phones with LiDAR sensors. Using a Meta Quest 2 controller as the test object—chosen for its complex geometry with a torus-like ring and a genus of 1, a combination of curved and flat surfaces, and interactable buttons—we conducted multiple mesh and 3D Gaussian Splatting (3D-GS) scans using two mobile apps: SiteScape for LiDAR-based point clouds, and Scaniverse for both mesh and Splat-based scans. The dimensional accuracy of each scanning technique was evaluated by comparing cloud-to-mesh distance of the generated models in the CloudCompare software against a highly accurate reference controller model from Meta, averaging the results of three models for each method to account for environmental variability. The models are then imported into Unreal Engine for a VR application to assess the controller's visual quality and interaction fidelity. The findings of this study provide a comparative analysis of the strengths and weaknesses of each method, offering insights into the most optimal mobile 3D scanning techniques for users to digitize small objects for interactive and immersive VR applications.

VR2049 **16:15-16:30**	Title: GSAC: Leveraging Gaussian Splatting for Photorealistic Avatar Creation with Unity Integration Author(s): Rendong Zhang, Alexandra Watkins, Nilanjan Sarkar Presenter: Rendong Zhang, Vanderbilt University, USA Abstract: Photorealistic avatars have become essential for immersive applications in virtual reality (VR) and augmented reality (AR), enabling lifelike interactions in areas such as training simulations, telemedicine, and virtual collaboration. These avatars bridge the gap between the physical and digital worlds, improving the user experience through realistic human representation. However, existing avatar creation techniques face significant challenges, including high costs, long creation times, and limited utility in virtual applications. Manual methods, such as MetaHuman, require extensive time and expertise, while automatic approaches, such as NeRF-based pipelines often lack efficiency, detailed facial expression fidelity, and are unable to be rendered at a speed sufficent for real-time applications. By involving several cutting-edge modern techniques, we introduce an end-to-end 3D Gaussian Splatting (3DGS) avatar creation pipeline that leverages monocular video input to create a scalable and efficient photorealistic avatar directly compatible with the Unity game engine. Our pipeline incorporates a novel Gaussian splatting technique with customized preprocessing that enables the user of "in the wild" monocular video capture, detailed facial expression reconstruction and embedding within a fully rigged avatar model. Additionally, we present a Unity-integrated Gaussian Splatting Avatar Editor, offering a user-friendly environment for VR/AR application development. Experimental results validate the effectiveness of our preprocessing pipeline in standardizing custom data for 3DGS training and demonstrate the versatility of Gaussian avatars in Unity, highlighting the scalability and practicality of our approach.
VR2051 **16:30-16:45**	Title: Virtual training system for laparoscopic cholecystectomy surgery Author(s): Ke Xu,Chaokun Yan,Yangkang Wei ,Wenli Zhang Presenter: Ke Xu, Henan University, China Abstract: Virtual Reality (VR) is a technology that uses computers to generate three-dimensional simulated environments, allowing users to interact with realistic scenes through visual, auditory, and even haptic feedback; laparoscopic surgery is a minimally invasive surgical technique in which several small incisions are made in the abdominal wall to insert a camera and specialized instruments to perform diagnostic and therapeutic operations. However, mastering this technique poses significant challenges for newly trained surgeons who lack clinical experience. To address this, our study has developed a VR-based training system for laparoscopic cholecystectomy. By constructing a highly realistic virtual surgical environment and simulating the interaction between surgical instruments and human organs, the system achieves a complete procedural simulation of gallbladder removal. The system architecture comprises three core modules: the view rendering module, responsible for visual presentation of the surgical scene; the interaction computation module, which handles the dynamic interactions between instruments and tissues; and the haptic feedback module, which provides authentic tactile feedback. Through the integration and optimization of these three modules, a lifelike simulation of laparoscopic cholecystectomy is realized, offering an effective virtual training platform for surgical education
VR3068 **16:45-17:00**	Title: Virtual Reality for Cognitive Behavioral Therapy: A Gamified Approach and Pilot Study with University Students Author(s): Mashael Bin Sabbar, Rich Davison, Gary Ushaw Presenter: Mashael Bin Sabbar, Newcastle University, United Kingdom Abstract: In this study, a Virtual Reality (VR) system was developed to integrate Cognitive Behavioral Therapy (CBT) techniques into an interactive and engaging experience using Oculus Rift. This study explores the gamification of CBT techniques to enhance user engagement and increase accessibility in mental health interventions. A structured software engineering approach was used to design and develop the system, ensuring a systematic implementation of therapeutic activities. A pilot study was conducted involving 28 university students to assess the usability, effectiveness, and user experience of the

	VR-based interventions. Findings suggest the gamified VR approach may increase engagement with CBT techniques and reduce short-term anxiety levels. The results give useful information on the usability of VR for mental health applications, offering a foundation for future research and system enhancements.
VR3076 **17:00-17:15**	Title: Promisedland: An XR Narrative Attraction Integrating Diorama-to-Virtual Workflow and Elemental Storytelling Author(s): Xianghan Wang, Chingshuan Hsiao and Shimei Qiu Presenter: Xianghan Wang, New York University, USA Abstract: Promisedland is a mixed-reality (MR) narrative attraction that combines cultural storytelling, ecological education, and an innovative hybrid production workflow. Set in a future Earth suffering from elemental imbalance, users embark on an interactive journey guided by symbolic characters to restore harmony through the collection of five classical elements: metal, wood, water, fire, and earth. To prototype this experience, we introduce a low-cost, high-fidelity Diorama-to-Virtual pipeline—handcrafting physical scale models, 3D scanning, and integrating them into Unreal Engine. This process enables rapid spatial prototyping while preserving the material expressiveness and narrative consistency of the physical environment. To further enhance immersion, the experience incorporates a Stewart Platform to provide motion feedback synchronized with the virtual ride dynamics, reinforcing spatial presence and embodied engagement. The final prototype runs on Meta Quest, supporting dynamic interactions and real-time visual feedback. Promisedland offers a replicable design blueprint for future XR narrative installations across museums, cultural exhibitions, and themed entertainment. It proposes a new framework for XR Narrative Attractions—where physical and digital elements converge to deepen immersion, agency, and emotional engagement.
VR3077 **17:15-17:30**	Title: The POMS Effect: Measuring the impact of overlapping architectures on User Engagement in Virtual Reality Author(s): Puru Ojha, Aaditya Vardhan Narain, Y. Raghu Reddy Presenter: Puru Ojha, IIIT Hyderabad, India Abstract: Natural walking offers high immersion in Virtual Reality (VR) but is constrained by physical space. Overlapping architectures, which reuse physical space, are a potential solution. Building on foundational principles of Architecturally Consistent Maze Generation in VR, we developed,implemented, and evaluated the Procedural Overlapping Maze System (POMS). POMS procedurally generates and prunes right-angled, overlapping maze corridors in real-time, enabling continuous natural walking in footprints ≥ 4x4m. This paper presents a controlled, betweengroup empirical evaluation (N=17 matched pairs) comparing POMS against a spatially equivalent static maze in an 8x8m tracked area using an Oculus Quest 3. Participants performed a time-constrained navigation task. We investigated effects on user engagement (time-on-task), usability (User Experience Questionnaire - UEQ), presence (igroup Presence Questionnaire - iPQ), and cybersickness (Simulator Sickness Questionnaire - SSQ). We hypothesized POMS would lead to increased time-on-task (H1), and that its dynamic nature would not negatively impact user experience, aiming for UEQ, iPQ, and SSQ outcomes comparable to a static environment (H2-H4). Results indicated no statistically significant differences in UEQ (H2) or iPQ (H3) between conditions, supporting our hypotheses that POMS could maintain these experiential qualities. Surprisingly, regarding cybersickness (H4), the increase in Oculomotor, Disorientation, and Total SSQ symptoms was significantly smaller in the POMS condition compared to the Static condition, while there was no significant difference for Nausea. This finding demonstrates an unexpected and substantial comfort benefit with POMS, exceeding our initial hypothesis of mere comparability. While POMS did not show a statistically significant increase in time-on-task (H1) in this study, a numerical trend suggesting longer engagement was observed. The markedly improved comfort achieved with POMS strongly suggests that such architectures have the potential to facilitate longer interaction periods, warranting further investigation into task design to fully leverage this benefit. These findings highlight that procedurally overlapping architectures like POMS can enable extended natural walking, not only without degrading core experiential qualities, but also by significantly enhancing user comfort.

VR3078 **17:30-17:45**	Title: VR Digital Twin-based Dynamic Dataset Synthesis for Learning Channel Disaster Detection Network Author(s): Yuhao Liu, Zhiqi Yan, Yong Zhao, Yiping Wang, Yiping Dong, Jianghua Zhang, Zhengrong Li ,Shaojun Hu Presenter: Yuhao Liu, Northwest A&F University, China Abstract: Channels are a major component of water conservancy infrastructure and play a crucial role in agricultural irrigation, industrial production, flood retention and discharge. Cracks, fractures, and blockages caused by large floating debris can destroy the structural integrity of concrete riverbanks. Therefore, real-time detection of potential disaster is of great significance for ensuring the safety and stability of channels. However, recent deep learning-based methods for detecting disasters heavily rely on the high-quality of datasets. Yet, in the real world, it is challenging to collect datasets covering channel cracks, fractures, and large floating debris. To address this problem, we propose a Virtual Reality (VR) digital twin-based dynamic dataset generation method for synthesizing videos of channel damages and floating debris that are difficult to be captured in real-world scenarios. First, we employ a multi-view image-based approach to recover camera poses and point cloud structures of the channels. Then, an epipolar line-based interactive editing method is used to construct a 3D channel model, while concrete cracks are reconstructed and augmented in a similar method. To generate high-quality dynamic scenes of fractures and damages, we adopt a 3D Voronoi diagram-based simulation method combined with a physics-based rigid body model. Next, a wave spectra-based approach is used to simulate turbulent flood in channel, while spherical quaternion interpolation is applied to model the motion of large floating objects such as cars and trunks. Finally, the synthesized data is annotated and used to train a YOLO deep learning model. Experimental results demonstrate that the synthetic dataset achieves a detection accuracy of over 96% on our test dataset with 30 fps, meeting the requirements for efficient and precise channel disaster detection.
VR4104 **17:45-18:00**	Title: Tactile-Enhanced VR Rehabilitation: Integrating Mixed Reality and Scene Transitions Author(s): Xinyao Chen, Mengjie Huang, Wendi Wang, Jiazhen Chen, Xintong Li, Kangqi Xu, Haoshi Yu, Rui Yang Presenter: Xinyao Chen, Xi'an Jiaotong-Liverpool University, China Abstract: Virtual Reality (VR) technologies are increasingly utilized in motor rehabilitation for their ability to create immersive, controllable environments that support therapeutic activities. However, the combined effects of tactile feedback and mixed reality (MR) transitions on user engagement and usability remain underexplored. To address this gap, we designed and implemented a modular VR rehabilitation system featuring customizable silicone-based tactile texture and seamless MR transitions, enabling dynamic switching between virtual and realworld stimuli. Through collaboration with clinicians at a local rehabilitation hospital, we optimized the system's therapeutic applicability, ensuring alignment with real-world rehabilitation requirements. A series of experiments involving participants systematically evaluated the system's impact across four perceptual dimensions (immersion, motivation, agency, and presence) by comparing four conditions: baseline VR, VR with tactile feedback, VR with MR transitions, and combined tactile+MR. Results indicated that tactile feedback alone achieved the highest perceptual scores, while the combination of tactile feedback and MR transitions also yielded high and stable ratings. The System Usability Scale (SUS) analysis demonstrated good usability (M = 72.3), with usability slightly exceeding learnability. These findings underscore the potential of simple, scalable tactile solutions combined with MR transitions to enhance engagement and usability in VR rehabilitation systems

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