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VR [we are] Training - Workshop on Collaborative Virtual Training for Challenging Contexts

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ABSTRACT

Virtual reality provides great opportunities to simulate various environments and situations as reproducible and controllable training environments. Training is an inherently collaborative effort, with trainees and trainers working together to achieve specific goals. Recently, we have seen considerable effort to use virtual training environments (VTEs) in many demanding training contexts, e.g. police training, medical first responder training, firefighter training etc. For such contexts, trainers and trainees must undertake various roles as supervisors, adaptors, role players, and observers in training, making collaboration complex, but essential for training success. These social and multi-user aspects for collaborative VTEs have received little investigation so far. Therefore, we propose this workshop to discuss the potential and perspectives of VTEs for challenging training settings. In a one-day online workshop, researchers and practitioners will jointly develop a research agenda on how currently underrepresented aspects of social and collaborative work can be integrated into VR-supported training. This workshop will focus on two themes: (1) Multi-sensory experience: novel collaborative interfaces for VTEs (e.g. joint use of tangible devices, strategies for preventing simulator-induced negative effects); (2) Multi-user interaction: collaboration in VTEs between trainers (two trainers run a scenarios jointly), trainers and trainees /the trainer controls the scenario for a trainee), and trainees with each other (e.g. two trainees solve an exercise together)

CCS CONCEPTS

• **Human-centered computing** → **Virtual reality; HCI design and evaluation methods; User centered design; Collaborative interaction; Mixed / augmented reality; Interaction design theory, concepts and paradigms; Computer supported cooperative work.**

KEYWORDS

VR training, Collaborative VR, Virtual Training Environment, Trainer Trainee Interplay

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1 BACKGROUND

Within the last years, we had the chance to observe a constant improvement in Virtual Reality (VR) technology, the so-called ‘second wave of VR’ [2]. Due to these recent innovations, VR systems – especially head-mounted displays (HMDs) – have become widely commercially available and are now used in various fields, e.g. entertainment [15], psychology [17], urban planning [25], CBRNE training [18], assembly training [26], etc. Fully immersive virtual training applications and virtual training environments (VTEs) are especially promising, as they can provide a controlled simulated environment that provides an (almost) realistic impression of a training situation to the user that allows for the repetition people need to master new skills or processes.

VR training turns the learner, or ‘trainee’, into an active user who has to physically and mentally engage to participate [16]. Furthermore, VR experiences can re-create extreme situations, allowing

users to evaluate different strategies and learn without severe consequences [18]. It eliminates risk, liability, and injury, while still allowing users to easily train and master procedures for real-life situations. In the 1990s, [4] already stated that Mixed Reality (MR) interfaces facilitate the development of innovative, seamless applications that can improve both in-person and remote collaboration. The field of Collaborative Virtual Environments (CVEs) aims to provide novel, effective ways of using VEs to work and collaborate together. Overall, immersive training environments have been used in various fields, e.g. physical [14], social and cognitive skills training [5], manufacturing [6, 8, 12, 31, 34], as well as medicine [1], emergency and safety training [9], and military training [13, 20, 23].

However, we have experienced in projects that investigated and developed VR-supported training possibilities that the conceptualisation and conductance of VR training can be especially challenging in complex training contexts, such as first responder training. For example, in police first responder training, individual, contextual, societal, and organizational factors influence decision-making and acting in the field which must be considered in training. Furthermore, such VR training demands trainers to take on different roles: they must observe and evaluate the trainees, adapt scenarios to achieve a high training value, and interact (e.g. as role players) in the training scenario. Trainees often have to take on different tactical roles in training as well. VR-supported training should thus enhance the ability of trainers and trainees to easily collaborate with each other in their given roles in order to achieve the specific goals of a given training.

Despite the early recognition of the benefits of immersive technologies - such as MR, AR, and VR - for collaborative learning and training, the topic has overall received little attention, with few papers focusing on integrating training and learning aspects of collaboration into VR research. For example existing contributions have focused on emergency response training [27], aircraft evacuation training [28] or surgical training [11]. To the best of our knowledge, the demands of VR-supported training for challenging contexts, in particular, have not yet been discussed with the wider CHI community.

Therefore, we propose this workshop, to jointly discuss the potential and perspectives of VTEs. In a one-day, online workshop, we will bring together researchers and practitioners to jointly develop a research agenda on how current underrepresented aspects of social and collaborative work, such as learning and training together, can be integrated into VR-supported training.

1.1 Themes

This workshop will focus on two main themes:

- Novel collaborative interfaces for VTEs
- Collaboration between trainer(s) and trainee(s) in VTEs

1.1.1 Novel collaborative interfaces for VTE. Social and multi-user aspects for truly collaborative VTEs have received far less investigation so far, as many systems are designed for single-person use only.

Some research has been conducted on synchronous collaboration in VR. e.g. on providing reviews and feedback in VR [19, 30], non-verbal interface for CVEs [10], and remote collaboration [21, 32].

However, these findings and considerations have not yet been transferred to the context of learning and training as parts of social and collaborative work.

We therefore consider it fruitful to debate which interaction approaches and interfaces are needed to provide meaningful cooperation and to support social work of multiple persons, especially persons with different roles and abilities (e.g. trainer and trainees).

In this theme we want to address these - non-exhaustive - topics: Use of tangible devices/interfaces as learning support or for better simulation of the context (e.g. fire hose in a fire exercise); Prevention of problems and errors (e.g. motion sickness, disinterest, distraction, etc.); Multi-sensory experience for better training simulation (including people's sense of smell, hearing, touch, etc.).

1.1.2 Collaboration between trainers, trainees and trainee(s), and trainees in VTE. The interplay between the trainer, who provides and controls the training, and the trainees, who participate in the training, is a promising field for research.

VR training builds competencies for instructors as well as trainees. Sharing a virtual environment fosters empathy (cf. [29]), allowing the trainer to move around and observe students as they experience the training scenarios. The instructors can annotate mistakes and provide constructive feedback in real-time. This way, the students can correct themselves while the instruction is still fresh in their minds.

Additionally, the training session can also be recorded and replayed later in 3D, to evaluate and review the actions of trainees and/or trainers in order to further improve the trained skills. Continuous, evolving feedback is especially valuable when people are trained for medical emergencies. Automated tracking and analysis of trainees' head or eye movements ([24]) another layer of customized feedback.

In this theme, we want to address these - non-exhaustive - topics: Innovative interaction concepts between trainer and trainee in VR (role plays, how to create a social bond/connection between trainer and trainee, collaboration between different trainer functions, etc.); Live manipulation of the virtual environment through the trainer in VR, allowing the trainer to change context and situation; Real-time performance measurements in VR and dashboards to visualize those measurements; Use of bio-signal measurements (e.g. heart rate, heart rate variability, eye tracking, etc.) for adaptive, individualized training, including automatized context-changes depending on the measurements; Didactic concepts for training in VR (e.g. familiarization, strategies to foster transfer and retention, etc.); Optimal ways to integrate, enhance and combine traditional with virtual training.

2 ORGANIZERS

2.1 Center for Technology Experience – AIT Austrian Institute of Technology

The Center for Technology Experience deals with fundamental questions about the interaction between people and technology. Based on interdisciplinary principles, they investigate qualities and forms of interaction alongside new methods and tools. User experience research and experience-driven innovation as well as new modalities of interaction have evolved into prominent and

required building blocks towards innovative and successful future technologies, applications, and services.

Georg Regal is a scientist at the AIT. He is responsible for the design and development of interaction prototypes. His research is focused on human augmentation, especially virtual reality and interfaces for people with disabilities.

Helmut Schrom-Feiertag is a scientist at the AIT and has specialized in analysis, modeling and simulation of pedestrian behavior, wayfinding behavior and evaluation of guidance systems in the context of urban transportation with a decade of experience in this field. He is currently coordinating the European project Med1stMR, that focuses on medical first responder training. Currently, he is working with VR as a test and training environment, focusing on user experience and behavior research in the context of future technologies and interaction design.

Quynh Nguyen is a junior scientist and PhD student at the AIT. In her research, she aims to develop, evaluate, and use co-creation for the human-centred, sustainable design of future technologies such as XR.

2.2 Institute for Fire-Service and Rescue-Technology - fire department Dortmund

In national and EU-wide research projects, the Institute for Fire and Rescue Technology, Dortmund, takes on the role of the practice-oriented end user and actively involves emergency service officers from the fire service in Dortmund. The institute provides its special value through its definition of requirements based on daily experience and of existing needs and through its ability to test and validate research with emergency services. These results influence the future work of the emergency services such as fire protection, rescue services, civil protection and disaster control on site.

Marco Aust is a chemist and has been a security consultant for almost ten years. He is responsible for education and training of emergency service workers. Since 2021, he is working as a scientist for the fire brigade, with a focus on unmanned aerial systems. He is especially interested in using VR to simulate extraordinary situations, e.g. to get used to adrenaline and over-stimulation. This provides the opportunity to not only train standard procedures but to assess one's mental and physical reactions in extreme situations and environments.

2.3 USECON

USECON is an internationally operating company with headquarters in Vienna. They support their customers in the challenges of digitisation and transformation, focusing on experience design, user research and interaction innovation from a user-centred point of view. In doing so, the 3 Us *Usability – User Experience – User Interface Design* are the center of their attention.

Markus Murtinger Since 2006, Markus has been responsible for conducting more than 100 strategic national and international user and customer experience projects. Markus is coordinating the European project SHOTPROS that focuses on police training in stressful situations. In his work, he focuses not only on strategic user and customer experience management but also on user-centred innovation and user satisfaction monitoring.

2.4 Center For Human-Computer Interaction – University of Salzburg

The Center for Human-Computer Interaction is an interdisciplinary research group at the University of Salzburg. Currently, approximately 40 researchers study the interplay between humans and computers in order to enable desired interactions and explore desirable futures. Projects at the Center for HCI take place in contexts that range from kindergartens to factories and include the cutting edge of technologies in areas such as autonomous driving, artificial intelligence, and assistive technologies.

Dorothe Smit is a Research Fellow at the Center for Human-Computer Interaction and a PhD student at the University of Salzburg. Her research focuses on embodied sensemaking in collaborative scenarios supported by hybrid tools, which include VR systems.

Manfred Tscheligi is a key person involved in developing the field of Human-Computer Interaction, a distinguished speaker at conferences, workshops, tutorials and seminars, and the author of many publications. He has initiated and managed a broad variety of national and international research, industrial projects, and initiatives, and has (co)-organized a wide set of workshops (e.g. CHI08 - "Surrounded by ambient persuasion" [22], CHI14 - "TouchMe" [33], CHI16 - "Fabrication and HCI" [7], CHI21 - "Automation Experience at the Workplace" [3]) and conferences (e.g. CHI04, MobileHCI17, Persuasive Technology16, ECSCW19 etc.).

2.5 Empathic Computing Laboratory - University of South Australia

The Empathic Computing Laboratory (ECL) is an academic research laboratory at the University of South Australia in Adelaide, Australia, and at the University of Auckland in Auckland, New Zealand. ECL is exploring new ways for technology to enable people to better understand one another. The key research themes are Empathic Computing, Collaborative Interfaces, Augmented Reality, Virtual Reality

Mark Bilinghurst is Director of the Empathic Computing Laboratory, and Professor at the University of South Australia in Adelaide, Australia, and also at the University of Auckland in Auckland, New Zealand. He conducts research on how virtual and real worlds can be merged, publishing over 550 papers on Augmented Reality, Virtual Reality, remote collaboration, Empathic Computing, and related topics. In 2013 he was elected as a Fellow of the Royal Society of New Zealand, and in 2019 was given the ISMAR Career Impact Award in recognition for lifetime contribution to AR research and commercialization

3 WEBSITE

A website¹ will be created in order to provide information about the workshop, the submission modality and links to related material, so candidates can familiarize themselves with the scope of the subject and goals of the workshop.

¹<https://xcelab.tech-experience.at/CHI22-workshop.html>

4 PRE-WORKSHOP PLANS

4.1 Target Audience

The overarching goal of this workshop is to bring together researchers and practitioners from various disciplines and backgrounds, to jointly develop a research agenda, to address how currently underrepresented aspects of social and collaborative work can be integrated into VR-supported training. Therefore, we aim to include a broad range of participants from various fields, and invite the perspectives from experts in work psychology, HCI and user experience, end-user organizations (e.g. trainers), and VR developers.

We will select participants based on the potential contribution they can offer to the workshop agenda. We will limit the number of participants to a minimum of 5 participants and a maximum of 15 participants.

To lower the barrier for participants from non-scientific organizations (e.g. end-user partners and practitioners) we will open the workshop to two forms of contribution. Participants can either submit a position paper (max. 4 pages ACM format) addressing one of the themes of the workshop (cf. Section 1.1 Themes). Participants can also choose to submit a motivation statement (max. 4 pages ACM format), describing their reasons for joining the workshop and/or what they would contribute towards the workshop agenda. In conjunction with this motivation statement, we ask participants for a description or speculation as to how their work already benefits from collaborative VR training, or how it might benefit in the future.

All submissions undergo a single blind review process by at least two reviewers.

4.2 Distribution

We will distribute the call for participation through mailing lists, newsletters, social media and on websites (e.g. ACM SIGCHI mailing lists, LinkedIn, Twitter, Facebook, websites of the organizing institutions, British HCI News, national and international CSCW mailing lists). We will also broaden the scope by reaching out to other communities, such as the Quality of Experience (QoE) community and the broader accessibility community (ACM SIGACCESS & ICCHP and AAATE community).

It is especially important for us to collaborate with end-user organizations and practitioners on the research agenda. To achieve this, we will use our established network in various national and international VR training projects (e.g. Lawtrain², VR Planning³, Virtual Skills Lab⁴, SHOTPROS⁵ and Med1stMR⁶).

5 IN-PERSON, HYBRID OR VIRTUAL-ONLY

This workshop will be held online between April 15 and April 30, thus between the online and the on site phase of CHI22.

²<http://www.law-train.eu/>

³<https://projekte.ffg.at/projekt/2716744>

⁴<https://projekte.ffg.at/projekt/3254984>

⁵<https://shotpros.eu/>

⁶<https://www.med1stmr.eu/>

We will use MS Teams⁷ for presentations and discussion, and collaborative tools (e.g. Miro⁸) to further support the online collaboration. We will use breakout rooms to provide the chance to discuss occurring themes in separate work groups. We will also use the VR platform Spatial.io⁹ for collaborative brainstorming and to provide a hands-on VR experience. After the workshop, we will host a voluntary, informal networking get-together and socialising event via the platform Wonder¹⁰.

All proposed tools will be evaluated to ensure accessibility for participants, and thus might be subject to change to provide better accessibility and/or a better participant experience.

6 WORKSHOP STRUCTURE

The workshop will be held as a one-day online event (9:00 to 17:00). We will decide on the concrete time-slot that suits the time-zones of most participants.

The workshop will start with inspirational statements (lightning talks) by three experts. We aim for one lightning talk by an expert in HCI and user experience, one talk centered around VR training's and one lightning talk about the end-users organizations perspective. This will be followed by a sessions in which participants present their positions, statements, and speculations. Building on the presented topics, we will select occurring themes and discuss them in dedicated break-out sessions. We aim for approx. three to four themes with three to five participants per break-out session). Subsequently, the themes will be presented and discussed with all participants. Based on the developed themes a joint research agenda statement will be developed. Lastly, we will host a voluntary get-together session in the evening.

Find the proposed timetable of the workshop below:

- 09:00-09:30: Introduction of workshop theme and goals. Introduction of organizers and participants.
- 09:30-10:30: Lightning talks (3 lightning talks, each 20 minutes)
- 10:30-10:45: Coffee break
- 10:45-13:00: Presentation of participants position statements and speculations
- 13:00-14:00: Lunch break
- 14:00-15:00: Collaborative brainstorming and hands on XR co-design session
- 15:00-15:15: Coffee break
- 15:15-16:15: Development of research agenda (breakout sessions)
- 16:15-16:45: Development of research agenda (plenary)
- 16.45-17:00: Wrap Up and follow up activities
- (18:30-19:30: Voluntary networking session and social event)

7 POST-WORKSHOP PLANS

The workshop will result in three main outcomes:

- First, the participants' submissions (position statements or motivation/speculation statement) will be published online on the workshop webpage and submitted to a preprint server

⁷<https://teams.microsoft.com/>

⁸<https://miro.com/online-whiteboard/>

⁹<https://spatial.io/>

¹⁰<http://wonder.me>

(e.g. arXiv¹¹), thus providing open access to the wider CHI, CSCW, UX, VR and QoE communities.

- Second, the workshop will result in a joint research agenda and declaration statement that will be released via the website. We strive to publish this research agenda and position statement in a peer-reviewed journal.
- Third, we will aim for follow up activities by positioning the research topic in special interest groups related to XR usage, e.g. XR4Europe¹², XR4all¹³. Here we can also rely on our network from multiple ongoing research projects in this area. Also we will set up a researchgate¹⁴ group to keep (interested) participants connected after the workshop.

8 CALL FOR PARTICIPATION

Virtual reality provides great opportunities to simulate various environments and situations as reproducible and controllable training environments. Recently, we have seen considerable effort to use virtual training environments (VTEs) in many demanding training contexts, e.g. police training, medical first responder training, firefighter training, etc.

The overarching goal of this workshop is to bring together researchers and practitioners from various disciplines and backgrounds in order to jointly develop a research agenda on how currently underrepresented aspects of social and collaborative work can be integrated into VR training.

Therefore, in this one-day online workshop we aim to discuss two themes around training in challenging environments: (1) Multi-sensory experience: novel collaborative interfaces for VTEs and (2) Multi-user interaction: collaboration between trainers and trainees. To express interest, participants can either

- submit a position paper (max. 4 pages ACM format) addressing one of the themes of the workshop or
- submit a motivation statement, describing their reasons for joining the workshop and what they would contribute towards the workshop agenda (max. 4 pages ACM format).

Deadline for submission is 24.02.2022. Submissions must be sent by email to vr-training@tech-experience.at. Further details can be found on the workshop web page: <https://xcelab.tech-experience.at/CHI22-workshop.html>.

All submissions undergo a single blind review process. We will select participants based on the potential contribution they can offer to the workshop. We are striving towards a diverse background of participants, aiming for a balance of researchers, practitioners, and end-user organizations.

At least one author of each accepted submission must attend the workshop and all participants must register for the workshop and for at least one day of the conference.

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¹¹<https://arxiv.org/>

¹²<https://xr4europe.eu/>

¹³<https://xr4all.eu/>

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