Experience 2.0 and Beyond – Engineering Cross Devices and Multiple Realities

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ABSTRACT

Today, augmented and mixed reality (AR/MR) are found very promising. Even current handheld displays, such as smartphones and tablets, can provide a wide and low budget access to such applications. New devices, like Apple's Vision Pro, smart tattoos[1] [8], interactive clothing, and wearables[2] propose an even higher immersion and are opening totally new exciting worlds for researchers, developers, and users. However, current research in this area faces many challenges, e.g., suitable interaction techniques, better user experience, navigation in MR environments, high cross-device UX, etc. These challenges are still limiting the usage of AR/MR application in real world activities. Targeting these challenges, our workshop will provide a platform for researchers, developers, and professionals to discuss issues and define novel methods and approaches suitable for developing the experience 2.0 and beyond: new interaction paradigms, user interfaces, 3D visualizations, and soundscapes, as well as applications for cross-device AR/MR.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; **Ubiquitous and mobile computing**; **Visualization**.

KEYWORDS

Augmented reality; mixed reality; spatial computing; handheld displays; head-mounted displays; mobile devices; human-computer interaction; visualization; and soundscapes.

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[1]https://www.microsoft.com/en-us/research/project/smart-tattoos/
[2]https://interactivewear.com.au/

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1 BACKGROUND

Augmented and Mixed Reality (AR/MR) applications that extend the physical world with virtual components have been deemed a promising technology in various domains including education, healthcare, entertainment, and industry. Apart from special AR/MR head-mounted displays (HMDs), handheld displays (HHDs) such as smartphones and tablets offer a widely available and low budget access to AR/MR environments. Despite the huge potential assigned to these technologies, applications in the real world are still rare.

In the context of AR/MR applications, a major challenge concerns the design and development of suitable interaction techniques. In contrast to head-mounted displays, tablets and smartphones were originally not designed for spatial user interfaces but for 2D applications. For these 2D applications, touch-based input has proven to be very suitable and established as an intuitive input paradigm across many cultures and generations. However, independent of the device used, AR/MR applications usually require 3D input. To this end, previous research has proposed various interaction techniques including one-handed in-air gestures (e.g., [1]), advanced touch-input (e.g., [6]), or device-based input which maps the HHD's position and orientation to virtual objects (e.g., [7]). These existing interaction techniques however come with different drawbacks including fatigue, occlusion, inaccuracy, and low learnability. Out-of-the-box interaction techniques for MR head-mounted displays (HMDs) typically rely on eye movement and hand gestures. Apart from research on advanced hand gestures (e.g., [2] and [12]), previous work has also proposed input techniques based on foot movement (e.g., [11]), voice (e.g., [9]), or multimodal systems such as combining HMDs with smartphones or smartwatches [3]. While Apple's Vision Pro attempts to reduce fatigue issues through hand tracking using downward-facing cameras, an easy-to-learn and accurate interaction method for 3D object manipulation (i.e., object translation and rotation) is still missing. Hand gestures, while considered a promising and intuitive input modality, have limited applicability for 3D manipulation because they are subject to the physical limitations of human hand and wrist movements. On top of that, existing interaction techniques are often developed for specific applications and hardware. However, to foster the application of

MR in real world settings, novel interaction paradigms are needed that are suitable for different devices and applications.

Hence, future research in this area should focus more on the following questions:

- Which of these interaction techniques (e.g., hand gestures, touch-gestures, facial gestures, device-based gestures, etc.) are suited best for which types of tasks, devices, and users?
- How the state-of-the-art interaction techniques and approaches can be improved to make them well suited for new sets of devices such as Apple's Vision Pro, interactive clothing, wearables, etc.
- How can we effectively teach new interaction paradigms when they are very different from well-established touch-based techniques?
- How can we guarantee the best possible usability across device classes? This includes, for instance, learnability – a user should not be forced to relearn all interaction paradigms just because changing from an HMD to a tablet.

Another challenge is related to the small screen size of HHDs which restricts the user's field of view in AR/MR applications. In this context, previous research has proposed different 3D visualizations for navigating to a point of interest that is currently out of view (e.g., [13]). While such visual cues can support navigation, they are also prone to visual clutter in more complex real-world settings. Hence, future work should deepen research toward appropriate navigation interfaces while considering the limited screen size.

Like with HMDs, the application of HHDs will often include physical actions like movement: hand-movements guided by vision; holding the display at a location that is interesting for MR; searching or traveling guided by knowledge or expectation; walking the HHD to a location where VR or AR is expected to enrich information / understanding / experience. During these actions, the visualizations should provide supporting information.

Targeting the above-mentioned concerns and challenges, we envision that the research must address the need to bring AR/MR applications and technologies to the mass using HMDs but also HHDs due to their availability and usage in daily life. Our workshop will provide a platform for researchers, developers, and professionals to discuss issues and define novel methods and approaches suitable for developing new cross-device interaction paradigms, user interfaces, 3D visualizations, and applications for AR/MR. Moreover, it will also be discussed how to make real-time AR/MR applications more intuitive and usable so they can be used in different domains. Researchers and practitioners are invited to submit contributions including problem statements, technical solutions, experience reports, planned work, and vision papers.

2 WORKSHOP TOPICS

The workshop will be dedicated to observations, concepts, approaches, techniques, development, and practice that allow understanding, facilitating, and increasing the advancements of AR/MR applications. Topics of interest for position paper submission include, but are not limited to:

- AR/MR applications for handheld devices and head-mounted displays
- User interface design for AR/MR applications in handheld devices and head-mounted displays
- New interaction techniques and modalities for AR/MR
- 3D Visualization for AR/MR applications
- Cross-device frameworks for AR/MR
- User experience in AR/MR
- Navigation in AR/MR
- Methodologies, frameworks, concepts, and tool support for cross-device AR/MR
- Evaluation and user studies
- Case studies and best practices
- Translation between senses [10]
- Multimodal interactive art [5]

3 WORKSHOP FORMAT AND REQUIRED SERVICES

3.1 Target Audience and Pre-workshop Plans

The intended audience of the workshop is a mix of industrial and academic participants with experience in multi-media and/or multimodal engineering or art. We expect around 15 active participants. Submitted position papers should be 4 to 8 pages long (excluding references) using the ACM Master Article Submission Templates (single column). The organizers will carefully review the submitted papers. The submissions will be reviewed based on workshop relevance, academic rigor, innovation, and industrial or artistic applicability. Accepted position papers will be available two weeks before the workshop date at the workshop website, and all participants will be assumed to have read these before the meeting.

3.2 Workshop Format and Activities

The workshop will have a strong focus on discussions and interactions between all accepted participants. The workshop will be held as a full-day synchronous workshop and consist of four 1.5 hours sessions: The workshop day will start with a keynote by a pioneer in the field of computer art or gaming, 30 minutes plus 10 minutes discussion. After that, each participant will briefly summarize her/his position (1 PPT slide, 3-5 min). The remaining sessions will start by a brief introduction by one of the organizers, based on the submitted positions, followed by interactive group discussion, each session aiming at a vision on prospective research agendas and educational challenges.

3.3 Workshop Website

The workshop has a dedicated website (http://hciv.de/xp2/), which is hosted on the HCIV (Human-Computer Interaction and Visualization) server (http://hciv.de/). HCIV is an official working group (WG 13.7) of the IFIP Technical Committee on Human-Computer Interaction (TC.13). The group has successfully organized multiple workshops as well as the European Conference on Cognitive Ergonomics (ECCE) in 2022. Additionally, the call for papers / contribution will be announced in all known relevant places and newsgroups.

3.4 Post-Workshop Plans

We will collect notes with questions/comments from participants during the presentations, discussions, and panels. We will use these

notes to keep track of all topics discussed in order to prepare a post-workshop summary to be available publicly on our workshop website. The extended version of workshop accepted papers will be published in the proceedings as a Springer LNCS book series. Furthermore, we will produce a special issue of a journal for which we will encourage authors of selected accepted workshop position papers to submit extended versions of their work. We have successfully done this many times in the past (see http://hciv.de/), e.g., [4].

4 ORGANIZERS' BACKGROUND

The team of organizers has successfully organized some workshops of the HCIV series (www.hciv.de). Following are brief sketches of each of the organizers.

Gerrit van der Veer is educator and researcher in Human-Computer Interaction and Cognitive Ergonomics at the Vrije University Amsterdam (VUA) since 1961. The VUA allowed him to teach at other Dutch universities, as well as in Romania, Belgium, Spain, Italy, and China. In 2005 he founded the VUA Department Multimedia and Culture. Currently he is guest Professor of Multimedia and Animation at the Lushun Academy of fine Arts in China. His research is on individual differences, mental models, task analysis, user interface design, service design, and interaction design for art and for cultural heritage. Gerrit was SIGCHI President and chaired the CHI conference twice (1993 Amsterdam, 2005 Portland, Oregon).

Shah Rukh Humayoun is an assistant professor at the Department of Computer Science, San Francisco State University, USA. His current research topics include new interaction modalities for smart devices, virtual reality and augmented reality, human-computer interaction, visual analytics for data science, and software engineering. He is Vice Chair of the IFIP WG 13.7 working group on Human-Computer Interaction and Visualization (HCHIV). Previously, he has co-organized more than 10 workshop at different venues (e.g., MobileHCI, INTERACT, RE, ICSE, ESEC/FSE)

Vera Marie Memmesheimer is a research associate at the Human Computer Interaction Lab, Department of Computer Science, RPTU Kaiserslautern-Landau, Germany. Her research interests include scalable visualization and interaction techniques for collaborative Mixed and Virtual Reality settings. She received her master's degree in Socioinformatics from the Department of Computer Science, TU Kaiserslautern, Germany.

Achim Ebert holds a degree and a doctor in Computer Science. He is a professor of Computer Science and is heading the Human Computer Interaction Lab at RPTU Kaiserslautern-Landau, Germany. He also is a member of the lead personnel of DFG's International Research Training Group (IRTG) "Physical Modeling for Virtual Manufacturing Systems and Processes". His current research topics include scalable information visualization, immersive scenarios, and human-computer interaction. He has founded and is co-heading the IFIP working group 13.7 on Human-Computer Interaction and Visualization. Achim co-organized more than 15 workshops and chaired the European Conference on Cognitive Ergonomics (ECCE) 2022.

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