ISMAR 2023 Workshop Proposal

1 Title of the Workshop

Hybrid User Interfaces: Complementary Interfaces for Mixed Reality Interaction

2 Acronym of the Workshop

HybridUI Workshop'23

3 Preferred Date for the Workshop

☐ October 16th (Monday)

☐ October 20st (Friday)

☒ No Preference

4 Presentation Mode

☐ Online

☐ Physically in Sydney

☒ Hybrid

5 Themes and Topics of Interest

Immersive augmented reality (AR) and virtual reality (VR) hardware is steadily pervading everyday life, with affordable off-the-shelf hardware becoming increasingly available to consumers. Most head-worn devices (HWDs)[1], however, solely rely on mid-air interaction as their main input modality. While this works well for spatial interaction (e.g., positioning objects in 3D space), their inherently limited ergonomics [1] and accuracy [6] present a critical challenge for wide adoption.

One promising possibility is the use of hybrid user interfaces, which merge the "*visual and interaction spaces [of] heterogeneous display and device technologies [to] take advantage of the strong points of each [device]*" [15]. Although hardware has improved significantly since the inception of hybrid user interfaces, their complementarity [44] for interaction still remains beneficial for mixed reality environments (see Figure 1): For example, AR HWDs can be used to seamlessly extend physical displays (e.g., desktops [15], smartwatches [19], smartphones [25], tablets [29, 35]), enable novel interaction techniques (e.g., slicing through 3D volumes [34]), and bridge the gap between 2D and 3D content (e.g., [5, 22, 23, 31]). Prior research has thus shown their benefits in different use cases such as sketching (e.g., [9]), debugging (e.g., [38]), 3D modeling (e.g., [36]) and—most prominently—immersive analytics [7] (e.g., [5,23,28,29,37,43]). In addition, using hybrid user interfaces *asynchronously* [24] (i.e., using complementary devices in sequence,

[1]We refer to "head-worn devices" instead of "head-mounted devices" (HMDs) to emphasize the increase in wearability of upcoming hardware.

Figure 1: Prior research has shown the benefits of hybrid user interfaces in a wide range of use cases. (A) Extending a desktop with an AR HWD to increase the available display space [15]; (B) Augmenting a large display wall into the third dimension through an AR HWD [37]; (C) Exploring novel interaction techniques for visual data analysis by combining tablets with an AR HWD [29]; (D) Investigating a seamless switch between analyzing data in-situ in an immersive VR environment and ex-situ on a desktop [22].

rather than simultaneously) can bridge the current gap between, for example, traditional desktop applications and immersive VR environments [22]: Through the use of transitional interfaces, users can switch between devices (and thereby realities) to seamlessly continue with their work, allowing users to choose the best environment and device combination for a given task.

Given their versatility and benefits, we believe that hybrid user interfaces can significantly improve interaction in mixed reality environments and contribute to a better integration between familiar (e.g., desktops and smartphones) and novel (e.g., AR and VR HWDs) devices. Yet, despite the large amount of prior work, there is a distinct lack of consistent models, terminologies, and technologies in this area, effectively fragmenting the research community across overlapping research areas such as cross-device interaction [4] and distributed user interfaces [10]. Our workshop therefore intends to bring together researchers and practitioners by establishing a dialog within the AR community, thereby creating a common ground and mutual understanding of this space.

5.1 Topics of Interest

The topics of this workshop include but are not limited to:

- Establishing a **taxonomy** of hybrid user interfaces by disseminating and discussing prior research.
- Exploring further **application areas** for hybrid user interfaces.
- Investigating potential **challenges and opportunities** in the design, use, and evaluation of hybrid user interfaces.
- Discussing novel **interaction techniques** that are enabled through the use of hybrid user interfaces (e.g., tablet lens [23, 34]).
- Examining the use of **transitional interfaces** for hybrid user interfaces (e.g., [31]) to enable fluid interaction [12].
- Creating a **roadmap** to guide future research in the area of hybrid user interfaces.

5.2 Goals

This workshop aims to establish a community of researchers, designers, and practitioners to consolidate the fragmented research community and share insights between researchers, paving the way for future collaborations. To this end, we aim to disseminate prior work to create a taxonomy of hybrid user interfaces, identifying key opportunities and grand challenges within this space. We will gather insights in a working document that we will further develop into a reference paper to inform future research.

6 Format of the Workshop

6.1 Pre-Workshop Plans

Our website (**https://hybrid-ui-workshop.io/**) will serve as information hub about the call for participation and the workshop's organizers, schedule, and submissions.

The call for participation will be distributed in relevant AR/VR/HCI communities, such as Twitter, Facebook groups, and mailing lists. We will also target specific researchers and practitioners that are actively working with hybrid user interfaces. While our website will serve as a central information hub, we will use a Discord server for asynchronous communication with all participants and a Miro board as a shared whiteboard for gathering material from workshop participants. In addition, important information will also be distributed by email.

To take part in the workshop, participants will need to submit a position paper between 2–4 pages long using the IEEE Computer Society VGTC format. We will collect submissions via email, thus keeping the process simple and avoiding potential accessibility issues with conference systems. The workshop organizers will select submissions based on their quality, originality, and relevance to the workshop.

The following key dates will be used by this workshop:

- Call for Participation: 19 May 2023
- Submission Deadline: 21 July 2023 (Anywhere on Earth)
- Acceptance Notification: 4 August 2023
- Virtual Kick-Off: 2 October 2023
- Workshop Date: *TBD*

6.2 Workshop Structure

The workshop is designed as a **hybrid, full-day** event. To accommodate participants and increase accessibility, the workshop will consist of asynchronous *pre-workshop activities* and hybrid *main workshop activities* during the conference.

6.2.1 Pre-Workshop Activities

We will use asynchronous communication tools (Discord) and a shared whiteboard (Miro) to (1) gather ideas and prior research to establish themes that will be used as material for main workshop activities; (2) build a community before the workshop officially commences; and (3) provide a common place for activities before, during, and after the workshop. The tools we employ will be provided and set up by the workshop organizers.

6.2.2 Main Workshop Activities

The main workshop during the conference will consist of two phases (see Section 6.3): First, a *presentation phase* will be dedicated to introducing the workshop organizers, highlighting key themes of the workshop with an opening keynote, and presenting as well as discussing the participants' submissions. Presentations will be projected using the conference center's infrastructure and shared in realtime via Zoom to remote participants, allowing for equal participation in presentations and discussions. The presentations will allow all participants to get to know each other and establish a common understanding of each other's works and application scenarios. While a coffee break and lunch provide the opportunity for local participants to engage in further discussions, we will provide an optional space for social discussions between remote participants.

The second half of the workshop will be dedicated to a *discussion phase*. Here, we will first gather topics based on participants' interests and ideas as well as predefined topics from the organizers and organize participants into breakout groups. Next, participants will discuss and work on these topics in their groups. Depending on the ratio of local to remote participants, we will either provide separate spaces for remote participants (e.g., breakout rooms in Zoom), or allow remote participants to take part in local breakout groups using Apple iPads (provided by the workshop organizers) and shared digital whiteboards: Here, remote participants will be represented by a local iPad in each group (i.e., similar to a hand-carried version of telepresence robots such as Double Robotics). A coffee break will encourage further social discussions among participants. We will again make use of the aforementioned iPad tablets to allow remote participants to join in local discussions during the coffee break. The workshop will conclude with a plenary discussion of the results of each breakout group, a closing keynote, and a wrap-up session providing a roadmap for future work. Participants will be invited to continue working on this topic through the asynchronous communication tools and shared whiteboards used during the workshop.

6.3 Tentative Workshop Agenda

	Presentation Phase
09:00	Preparation and Introduction
09:30	Opening Keynote
10:00	Coffee Break
10:30	Participant Presentations
12:00	Lunch
	Discussion Phase
13:30	Organization of Discussion Topics
14:00	Work in Breakout Groups
15:00	Coffee Break
15:30	Synthesis and Presentation of Results
16:00	Closing Keynote
16:30	Future Work and Wrap-up

7 Publication in Proceedings

☒ Yes

☐ No

8 Organizers

Name	**Sebastian Hubenschmid**
Affiliation	University of Konstanz, Germany
Contact Email	Sebastian.Hubenschmid@uni-konstanz.de
Research Interests	Hybrid user interfaces; transitional interfaces; immersive analytics
Short Bio	Sebastian Hubenschmid is a research assistant in the Human-Computer Interaction Group at the University of Konstanz. He published several hybrid user interfaces with novel interaction techniques [5, 22, 23, 25] and investigated challenges within asynchronous hybrid user interfaces [24] and complementary interfaces [44].
Homepage	https://hci.uni.kn/staff/hubenschmid

Name	**Johannes Zagermann**
Affiliation	University of Konstanz, Germany
Contact Email	johannes.zagermann@uni-konstanz.de
Research Interests	Complementary interfaces; cross-device interaction; multimodal interaction; hybrid user interfaces
Short Bio	Johannes Zagermann is a research assistant in the Human-Computer Interaction Group at the University of Konstanz. He studies complementary interfaces [44] and explores novel evaluation methods for cross-device interaction [46], multimodal interaction [45], and hybrid user interfaces (e.g., [22–25, 43]).
Homepage	https://hci.uni.kn/staff/zagermann

Name	**Raimund Dachselt**
Affiliation	Technische Universität Dresden, Germany
Contact Email	raimund.dachselt@tu-dresden.de
Research Interests	Interactive data visualization beyond the desktop; interactive surfaces; multimodal interaction; physical computing; mixed reality interfaces
Short Bio	Raimund Dachselt is the head of the Interactive Media Lab Dresden at the Technische Universität Dresden. At the end of 2015, he was appointed director of the Institute of Software and Multimedia Technology. His projects include award-winning papers that explore the design space of hybrid user interfaces, interaction techniques, and application areas (e.g., [20, 21, 28, 29, 34, 37]).
Homepage	https://imld.de/en/our-group/team/raimund-dachselt/

Name	**Niklas Elmqvist**
Affiliation	University of Maryland, College Park, USA
Contact Email	elm@umd.edu
Research Interests	Data visualization; human-computer interaction; visual analytics
Short Bio	Niklas Elmqvist is a professor of information and computer science at University of Maryland, College Park, USA and the former director of UMD's Human-Computer Interaction Laboratory (HCIL). Since starting as a faculty member in 2008, his work has focused on immersive, situated, and ubiquitous analytics [11] to support sensemaking anytime and anywhere. In 2023, he was appointed Villum Investigator to establish the Center for Anytime & Anywhere Analytics (CA3) at Aarhus University, Denmark. As part of his research in distributed user interfaces [10], he published award-winning hybrid user interfaces [20–22, 39] to study *fluid* interaction [12].
Homepage	https://sites.umiacs.umd.edu/elm/

Name	**Steven Feiner**
Affiliation	Columbia University, USA
Contact Email	feiner@cs.columbia.edu
Research Interests	Human-computer interaction; augmented reality; virtual reality; 3D and 2D user interfaces; automated design of graphics and multimedia; mobile and wearable computing; health applications; computer games; information visualization
Short Bio	Steven Feiner is professor of Computer Science at Columbia University, where he directs the Computer Graphics and User Interfaces Lab. He coined the term "hybrid user interfaces" [15] and together with his students created some of the first prototypes within this space [2, 3, 8, 14, 15, 40].
Homepage	https://www.cs.columbia.edu/~feiner/

Name	**Tiare Feuchtner**
Affiliation	University of Konstanz, Germany
Contact Email	Tiare.Feuchtner@uni-konstanz.de
Research Interests	User representation; embodiment; novel user interfaces for immersive cross-reality technologies, transitional interfaces, hybrid user interfaces
Short Bio	Tiare Feuchtner is a tenure-track professor at the Department of Computer Science of the University of Konstanz since 2021. Her work focuses on embodiment and novel user interfaces for immersive cross-reality (XR) technologies to create believable experiences of co-presence and effective tools for collaboration in cross-reality through embodied, transitional, and hybrid user interfaces. She created novel user interfaces for immersive technologies [13,16,17], investigated complementary interfaces [44], and recently organized an ISS workshop on transitional interfaces [27] which led to a set of challenges for asynchronous hybrid user interfaces [24].
Homepage	https://hci.uni.kn/staff/feuchtner

Name	**Benjamin Lee**
Affiliation	University of Stuttgart, Germany
Contact Email	Benjamin.Lee@visus.uni-stuttgart.de
Research Interests	Immersive analytics; augmented/virtual reality; data visualization; human-computer interaction
Short Bio	Benjamin Lee is a post-doctoral researcher at VISUS, University of Stuttgart. His work has investigated the use of (virtual) surfaces and tabletops in supporting collaborative immersive analytics [30,32,42]. His later work explored on how data visualizations can move and transition between 2D surfaces and the 3D space to accommodate the dynamic workflow of analysts in immersive environments [31,33].
Homepage	https://www.visus.uni-stuttgart.de/en/institute/team/Lee-00006/

Name	**Harald Reiterer**
Affiliation	University of Konstanz, Germany
Contact Email	Harald.Reiterer@uni-konstanz.de
Research Interests	Interaction design; usability engineering; information visualization
Short Bio	Harald Reiterer is a professor at the University of Konstanz and a Chair for Human-Computer Interaction, Department of Computer Science. His framework of *blended interaction* [26] led to the creation of novel interaction techniques in hybrid user interfaces (e.g., [5,22,23,43]) and their classification as complementary interfaces [44].
Homepage	https://hci.uni.kn/staff/reiterer

Name	**Dieter Schmalstieg**
Affiliation	Graz University of Technology, Austria
Contact Email	schmalstieg@tugraz.at
Research Interests	augmented reality; virtual reality; computer graphics; visualization; human-computer interaction
Short Bio	Dieter Schmalstieg is a full professor and head of the Institute of Computer Graphics and Vision at Graz University of Technology, Austria. In 2023, he was awarded with the Alexander von Humboldt professorship at the University of Stuttgart, Germany. His work is fundamental to the space of augmented reality [41] and has resulted in novel hybrid user interfaces [19] and toolkits that help to create such interfaces [18].
Homepage	https://tugraz.at/institute/icg/research/team-schmalstieg/

9 Potential Program Committee Members

Name	Affiliation	Confirmed
Sebastian Hubenschmid	University of Konstanz, Germany	Yes
Johannes Zagermann	University of Konstanz, Germany	Yes
Raimund Dachselt	Technische Univeristät Dresden	Yes
Niklas Elmqvist	University of Maryland, College Park, USA	Yes
Steven Feiner	Columbia University, USA	Yes
Tiare Feuchtner	University of Konstanz, Germany	Yes
Benjamin Lee	University of Stuttgart, Germany	Yes
Harald Reiterer	University of Konstanz, Germany	Yes
Dieter Schmalstieg	Graz University of Technology, Austria	Yes

10 Audience

We expect around 20–25 participants (including workshop organizers) with a total of 10–15 submissions.

11 Call for Participation

Hybrid user interfaces combine the visual and interaction spaces of complementary device technologies (such as augmented reality headsets and handheld devices) to take advantage of the strong points of each. With the proliferation of mixed reality hardware, there has been an increasing research interest in hybrid user interfaces. However, prior research shows a fragmented landscape with inconsistencies in terminology, models, and technologies within this space and overlapping research streams such as cross-device interaction and distributed user interfaces. We invite academics, designers, and practitioners to help create a common understanding and explore the opportunities and challenges of hybrid user interfaces, thereby generating a research agenda for this nascent space. Relevant topics include, but are not limited to:

- Fundamental research questions
- Application areas
- Interaction techniques
- Evaluation methods
- Opportunities and challenges
- Transitional interfaces between devices

We invite submission of position papers of 2–4 pages (excluding references) in the IEEE Computer Society VGTC format to submission@hybrid-ui-workshop.io. The organizers will select papers based on their quality, originality, and relevance to the workshop. Accepted papers will be published with a DOI and citable link in the ISMAR 2023 adjunct proceedings and IEEE Xplore. Upon acceptance, at least one author of each submission must attend the workshop (i.e., register for the workshop and at least one day of the ISMAR'23 conference).

Important Dates:

- Submission Deadline: 21 July 2023 (Anywhere on Earth)
- Acceptance Notification: 4 August 2023
- Virtual Kick-Off: 2 October 2023
- Workshop Date: *TBD*

For more details, visit our website at `https://hybrid-ui-workshop.io/`!

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