Co-Designing Immersive Virtual and Extended Reality Systems for Remote and Unsupervised Interaction, Intervention, Training and Research

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Abstract. We propose a one-day transdisciplinary workshop in the broad area of HCI focused on co-designing immersive virtual reality (IVR) for remote and unsupervised interaction, intervention, training and research. The development and deployment of such systems is a significant and important challenge. While remote and unsupervised systems are more accessible to a wider user-base, their design, implementation and deployment poses unique challenges, related to the need to involve truly transdisciplinary design teams, co-designing solutions with users, providing step-by-step interaction scenarios, and retaining user motivation and engagement over longer periods of time. Moreover, there are multiple ethical considerations related to both the inclusivity and accessibility of such systems and the security of data collected. Therefore, to facilitate the use of IVR systems in various contexts, ranging from unique interactions and research, through psychological interventions, to education and training, we propose to formulate a set of best practices. Taking into account the diverse aspects involved, we will formulate actionable guidelines for co-designing such solutions with users based on review of extant literature, expert knowledge, case studies and insights from the workshop.

Keywords: human-computer interaction· immersive virtual and extended reality systems · remote and unsupervised interaction · co-design· participatory design · transdisciplinary collaboration.

1 Theme and Topics

1.1 Theme

Virtual environments may be used in a variety of contexts. However in our workshop we would like to focus on four main areas of IVR applications: (1) research and development, (2) training and simulation, (3) healthcare and well-being and (4) entertainment and intersection with the arts. The entertainment domain excepted, the majority of IVR applications are typically deployed in lab settings for research purposes. For example, virtual environments to treat physical ailments like pain (e.g. in the context of pain management therapy with burn victims and cancer patients[6]) or psychological disorders, such as PTSD and phobias[1] (in the context of CBT and exposure therapy) have been tested in various studies and show promising results but are still not applied to everyday therapeutic practice. This is influenced by the limitations of IVR equipment and lack of know-how and established practices.

Nevertheless, as VR hardware continues its rapid evolution, new application domains are starting to emerge, making the benefits of IVR available to research, training or entertainment activities outside the lab. Against this backdrop, designing complex solutions for remote and unsupervised operation is increasingly becoming the next frontier of IVR development.

One of the major challenges of these diverse IVR systems stems from the wide variety of contexts they may be applied to. They may be deployed as a part of therapy at mental health clinics. They can be used to conduct research in a network of laboratories across the globe or at home [3]. They can also find uses at hospitals during prolonged isolation to foster well-being (e.g. in patients with leukemia).

They may be used for training at home, at the office or training centre or even in ICE (isolated, confined and extreme) conditions for training and simulations (e.g. Polar research stations, analog missions, ISS). They may also simply enable new ways of interaction with art via novel immersive artistic experiences or with educational content, such as architectural reconstructions and historical reenactments. The research potential of such activities and applications is massive, not only because of their wide-ranging applicability, but also their capacity to facilitate additional collection of quantitative data useful for research or to fine-tune interactive designs. A growing number of commercially available head mounted displays (HMDs)

have in-built eye-tracking and data collection capabilities, allowing users and researchers to benefit from psycho-physiological insights. Additionally, such quantitative data can be simultaneously gathered and complemented by data from other devices, such as low-cost smartbands.

All of these contexts and opportunities present unique challenges and considerations related to the co-design of IVR systems that are to be used remotely, in an unsupervised way [4]. Therefore, during our workshop, participants and invited experts will contribute and discuss case studies, best practices and strategies for each aspect of designing IVR solutions. As an output of the workshop

we will formulate guidelines for co-designing IVR solutions for remote and unsupervised use.

1.2 Key Workshop Topics

Although immersive virtual and extended reality systems may provide best quality of experience for use remotely in an unsupervised way [7], especially in the context of ecological validity, their design, development and deployment still pose a challenge. This workshop will focus on key aspects of designing remote and unsupervised virtual immersive systems for interaction, intervention, training and research. Preliminary interest areas are listed below.

Transdisciplinary collaboration in the design teams Combining competences from various disciplines to facilitate the process of designing such solutions is crucial for the development of research-informed applications for diverse uses. However, forming a team of experts with different backgrounds and skills can be challenging, especially as such teams ought to include artists, UX designers, engineers, computer scientists, and psychologists as well as facilitators.

Co-designing solutions with users Directly involving users in designing solutions is crucial, especially if they are to be used in an unsupervised way. This is necessary to limit dropout. This means that users ought to be involved from the earliest steps of design, during the concept, flow, UI and prototype stages. While HCI provides a wide body of knowledge on co-designing solutions with users in general, IVR-specific guidelines for co-designing [2], especially taking into account unsupervised and remote use of applications, are lacking.

Users' engagement, motivation and retention Such unsupervised remote IVR applications offer access to a greater diversity of participants/users from across the globe. There is great potential to reach cohorts previously under-/unsupported with in-vivo provisions (e.g. in the context of mental health, anxiety conditions with high avoidance or MHCs with associated stigmas). To retain users to the end of expected immersive experiences in unsupervised contexts, such applications also ought to provide cognitive ease of use, and contain step-by-step use instructions and comprehensive interaction scenarios which are possible to complete in an unsupervised way. These solutions may also contain gamification or edutainment elements, to motivate users and prevent dropout.

Step-by-step study design considerations Ecologically valid conditions are inherent to unsupervised remote studies, making insights gathered from them closer to real-life. However, considering the need to provide comparable experience, it is necessary to keep in mind diverse conditions of use, such as users' homes, therapy offices, hospitals or distributed living labs, which may differ in various aspects [5].

Another consideration is related to interaction length and schedule, both singular IVR session length and long-term commitment schedule as well as other aspects that may be relevant regarding the IVR purpose, target and application. Different methods of providing remote support to participants/users ought to be considered taking into account users' electronic literacy.

Limitations, ethics, inclusivity and accessibility When designing virtual systems for remote and unsupervised interaction, intervention, training, and research, it is important to consider limitations as well as ethical and social implications. We should consider potential risks and benefits, as well as how the system could differentially impact groups of people. We should also ensure that the system is accessible and inclusive to a diverse range of users.

Methods and security of data collection One of the crucial aspects of gathering representative data and ensuring continued use is keeping immersion in the system. It is especially important while gathering research and feedback data via in-IVR surveys, recording responses, recording various activities in immersive virtual environment. Another important aspect is the quality of data collection, potential for pushing study updates & adjusting experiences based on feedback/performance/use as well as available equipment and future device needs, e.g. high quality standalone HMDs. Another aspect is ensuring both the actual and perceived security of data collected in such remote studies and compliance of data collection methods with international and national law. This is important not only for scientific research but IVR application in general.

2 Organizers

Key organizers: Wiesław Kopeć, PhD, MBA, (Google Scholar Profile), Head of XR Center, Computer Science Department, Polish-Japanese Academy of Information Technology (PJAIT); **Monika Kornacka**, PhD, (Google Scholar Profile), Head of Emotion Cognition Lab, Institute of Psychlogy, SWPS University of Social Sciences and Humanities (SWPS); **Grzegorz Pochwatko**, PhD, (Google Scholar Profile), Head of Virtual Reality and Psychophysiology Lab, Institute of Psychology, Polish Academy of Sciences (IP PAS); **Cezary Biele**, PhD, (Google Scholar Profile, Head of Laboratory of Interactive Technologies, National Information Processing Institute (NIPI).

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3 Target Audience

We invite practitioners and researchers, in the broad area of HCI, who work with virtual immersive systems. These may be artistic or historical immersive systems meant to provide users with unique experiences, systems that aim to offer psychological interventions, training systems offering hands-on experiences of using complex machinery, or simulating unique work conditions. Finally, we welcome researchers who seek to design and use IVR technologies to facilitate delocalized research either outside of their laboratories or in cooperative networks of labs.

3.1 Expected Contributions

Each workshop participant is asked to prepare either:

- a short position paper (of 2-4 pages) bringing examples from their own practice related to designing and using virtual immersive systems for interaction, intervention, training or research, exploring challenges and opportunities of deploying them for use in an unsupervised and remote way,
- a short demo of a virtual immersive system or a presentation of prototype of a virtual immersive systems for interaction, intervention, training or research with a 1-2 page abstract situating the demo within the workshop theme.

4 Methods, Objectives and Expected Outcomes

4.1 Methods

We propose a one-day exploratory workshop. We aim to facilitate the exchange of best-practices in the form of interactive presentations, all in a friendly atmosphere, without strict presentation formats, where the participants may add their own topics of interest and expertise. In the course of the workshop our facilitators want to use some tools to aid free thinking, discussions and no-judgment brainstorming sessions, like mind-mapping or affinity diagramming. During the workshop we will also divide into topical teams based on their common experience and interests to work out specific considerations and insights, which at the end will be collected into a common matrix of guidelines.

4.2 Objectives

In organizing this workshop we have three key objectives:

- Establishing common ground and voice for the discussion of the challenges and opportunities related to the future broad use of immersive virtual and extended reality systems for remote and unsupervised interaction, intervention, training and research outside of research laboratories.
- Exchanging experiences and best practices for co-designing virtual immersive systems in transdisciplinary teams.
- Working out guidelines for co-designing immersive virtual and extended reality systems for remote and unsupervised interaction, intervention, training and research.

4.3 Expected Outcomes

We would like the outcomes to be applicable. Therefore, our key motivation is to discuss and generate practice-based guidelines for the design and co-design of virtual immersive systems for remote unsupervised interaction, intervention, training and research. These guidelines will form the basis for a post-workshop paper on the same topic, which will delve into the relevant related literature, and discuss insights gathered from experience-based cases presented by participants. This multidisciplinary publication will be disseminated to practitioners via a recognized research venue.

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