

Life goes on: Designing the Digital Periphery of Immersive Experiences

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Figure 1: Immersive experiences taking place within everyday life, bringing up questions of safety, communication and social interaction. (source: author)

Abstract: Extended reality (XR) offers highly immersive experiences. At the same time, users are still embedded in everyday life. Designers need to consider the context of immersive experiences, e.g. being situated within shared physical and social environments. In this paper, we propose the concept of the digital periphery – the hybrid space where immersive XR activity intersects with its physical surroundings. Further, we introduce a scenario-based, embodied co-design method as part of a workshop frame. The method allows for an ethical exploration of this space at an early, pre-resolution stage of the design process to surface latent frictions, asymmetries, and ethical tensions between immersed users and those around them. As an output, it supports collective sense-making around ethical, social and interactional tensions emerging in the digital periphery.

Keywords: XR design methodology; digital periphery; scenario-based co-design; embodied design research

1 Introduction

Extended reality (XR) technologies are increasingly moving into everyday environments, such as homes, workplaces, and public spaces. This is beneficial, as new applications (e.g. in the context of entertainment, work safety, and navigation) are made accessible to users. At the same time, this development poses new challenges: XR interaction happens embedded in the spatial and social context and thus also affects people indirectly, from bystanders to colleagues, from flatmates to family members. While these are not the primary users of the XR interaction, they are stakeholders and thus should be considered in the design of such interactions.

Designing immersive systems as self-contained, cut-off digital spaces risks producing what can be described as black-box experiences – opaque to those who share the same physical environment: People in the same situation cannot see, interpret, or influence what is happening inside the XR experience. This opacity raises questions not only of usability, but also of trust, safety, accessibility, acceptance, and social accountability.

Historically, other media have had their own ‘peripheries’ – reading a book, watching television, listening to a radio with headphones, playing a captivating video game: all these can raise different tensions with those not involved. Today, the

breadth of immersive media – from mobile phone usage, sometimes already including XR applications, to new wearables that may be used in the future – shows how the boundaries of attention, immersion and interaction need to be sensitively designed. This includes types of interaction that ‘overwrite’ our natural senses (such as XR glasses), but also subtle and potentially hidden interactions (such as AI-powered pins that listen and watch without being noticed by bystanders).

While many media technologies create forms of attentional separation, XR introduces several characteristics that intensify these dynamics. Unlike television or smartphones, immersive XR systems may partially replace or augment the user’s perceptual field, making it difficult for surrounding actors to understand what the user perceives, attends to, or intends to do. At the same time, XR interactions are often embodied and spatial, meaning that actions performed in virtual environments can have direct consequences for people sharing the same physical space. These characteristics make questions of awareness, accountability and social coordination particularly salient.

We believe that this boundary space, the overlap of immersive digital experiences and the physical, social world, is often overlooked. This is unfortunate, as it is a critical design space in which questions of communication, safety, and co-presence are actively negotiated. Building on perspectives of situated action (Suchman, 1987), embodied interaction (Dourish, 2001), and peripheral awareness (Weiser & Brown, 1996), we propose a simple name for this zone: the digital periphery.

We propose to define the digital periphery as the social, technical, and ethical overlap zone of immersive experiences and the real world, including its tensions, which are negotiated by the immersed users and surrounding stakeholders.

Rather than treating interactions in the digital periphery as side effects of the ‘real’ interaction with the system, we argue that these must be carefully designed. However, conventional methods are often not suitable for exploring this space. Mainly, this is because of timing issues: before concrete interfaces, interaction techniques, or success criteria have been defined, a ‘digital periphery’ doesn’t become palpable, but once the XR interaction has been designed, it may be considered as ‘too late’ to design the periphery.

We focus on XR interaction in this paper because it is rich in contrasts and challenges: XR interaction embodies physical risks (e.g. collisions with others and objects) while it, at the same time, destabilizes the social fabric (e.g. through actions that can’t be understood or predicted by bystanders, as they do not see and hear what the immersed person sees). Consider a parent using a VR headset while supervising a child at home, a pedestrian relying on AR navigation in a crowded public space, or an employee participating in an immersive XR meeting while colleagues move through a shared office. In each case, the XR experience extends beyond the primary user and affects surrounding people who may have different goals, responsibilities, and expectations. These situations are not merely technical challenges but also social and ethical ones, as they require participants to negotiate attention, availability, safety, and mutual understanding across digital and physical realities.

To address this gap, we propose a scenario-based, embodied co-design method that uses role-play and performative enactment to explore the digital periphery in situated, everyday contexts. Adopting a sensitising perspective for designers, it treats moments of breakdown, confusion, and discomfort as productive source material through which latent interactional dynamics can be surfaced and reflected upon.

1.1 Contribution

This paper contributes to XR design research in two ways. First, it introduces the concept of a ‘digital periphery’ as a lens for understanding the social, technical and ethical overlap between immersive XR experiences and their surrounding environments. Second, it presents and reflects on an embodied, scenario-based co-design approach that supports the early exploration of tensions and design opportunities emerging within this overlap zone.

2 Background

The relevant related work that provides the backdrop for this paper can be structured into the following fields of research: XR application design, safety, and communication. We also provide an overview of existing approaches to embodied enactment and elicitation methods.

As XR technologies become increasingly embedded in social and domestic contexts, designers must also address broader concerns such as safety, accessibility, and communication within hybrid environments. Understanding how immersive systems intersect with everyday social practices is therefore critical. The suggested approach aligns with work on embodied design practice and situated action, emphasizing that interactional meaning emerges through context-sensitive engagement.

2.1 Design of XR Applications

The design of XR applications has traditionally emphasized intuitive, immersive, and engaging digital environments. Research highlights factors such as spatial fidelity, interaction techniques, and adaptability to user needs as central to effective XR experiences (Bowman et al., 2012). More recently, inclusivity and accessibility have gained attention, acknowledging the diversity of users and contexts in which XR systems operate.

2.2 Safety in XR Environments

Physical safety remains a significant concern in XR use, as immersive systems often obfuscate awareness of the surrounding physical environment. Risks range from physical injury due to constrained vision and movement to psychological stress and disorientation. A recent review identifies key ergonomic challenges in immersive VR, including cybersickness, visual fatigue, muscular fatigue, acute stress, and mental overload (Souchet et al., 2023).

Existing mitigation strategies, such as boundary systems and environmental awareness features, offer partial solutions. However, they largely focus on the individual user and often neglect how XR systems affect, and are affected by, others who share the same physical space (Kourtesis, 2024).

2.3 Communication Across Realities

Interactions between XR users and bystanders introduce additional challenges, particularly in collaborative or socially shared contexts (Doroudian, 2023). Research shows that virtual content presented outside a user's field of view is perceived as significantly less socially present, affecting how XR users perceive others – and are perceived – during the interaction (Miller & Bailenson, 2021).

While prior work has explored technical approaches to bridging this gap, such as shared displays or audio-visual cues (Cools et al., 2023), less attention has been paid to design methods that help designers explore these hybrid dynamics early in the process. This background underscores the need for approaches that explicitly address the ethical and social realities of shared XR use.

2.4. Embodied and Scenario-Based Design Methods

Scenario-based and participatory design approaches are commonly used to explore emerging technologies and future use situations before concrete systems have been implemented. By enabling participants to enact and reflect on possible interactions, these approaches help uncover stakeholder perspectives, contextual influences, and potential design challenges early in the design process. (Sanders & Stappers, 2008)

Embodied co-design methods such as role-play, bodystorming (Oulasvirta et al., 2003), and design games (Brandt, 2006) further support this exploration by making social and spatial dynamics directly experienceable. Previous work has shown that such approaches can reveal tacit knowledge, interactional breakdowns, and tensions that may be difficult to identify through interviews or other reflective methods alone (Höök, 2008).

Our approach builds on these established traditions rather than proposing a fundamentally new design method. Instead, we adapt embodied scenario-based exploration to the study of the digital periphery in XR contexts. By focusing on the relationship between immersed users and surrounding stakeholders, the workshop format aims to make visible the social, ethical, and interactional tensions that emerge at the boundary between immersive experiences and everyday environments.

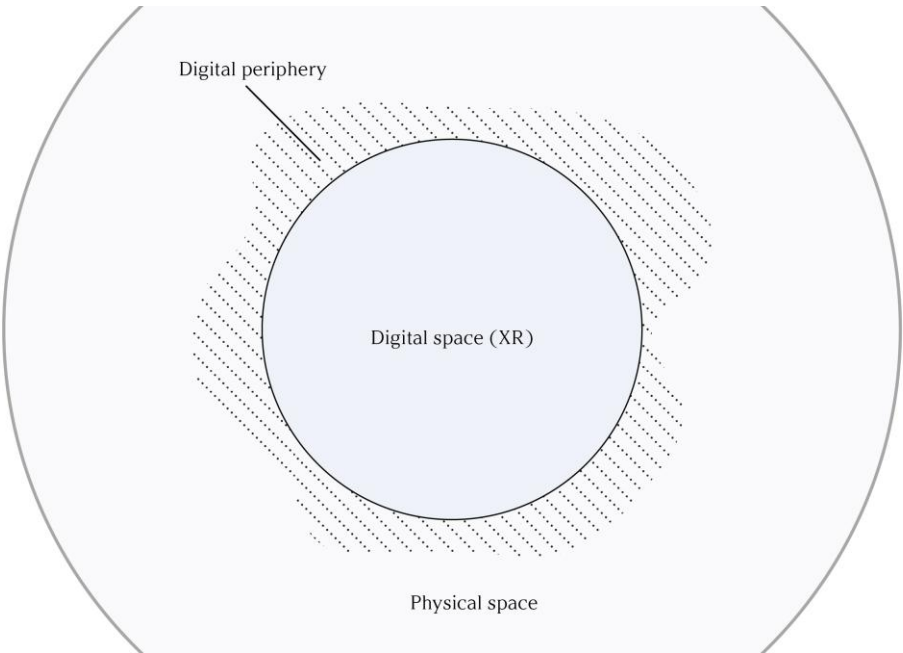


Figure 2: Schematic illustration of the digital periphery as a liminal area between the physical and digital worlds. (source: author)

3 Methodology

The two contributions of this paper are methodologically supported as follows: After a preliminary definition of the concept of a ‘digital periphery’ and its different facets, we present a method to elicit tacit dynamics of an XR interaction, while it is being conceived. Then, we report from conducting the method as described. Lastly, we reflect the findings.

The methodology presented in this paper is exploratory. Adopting a research-through-design perspective, the method was designed to surface interactional frictions, asymmetries, and ethical tensions in hybrid XR situations.

The introduced method prioritizes situated, embodied experience and collective reflection to surface interactional dynamics that are typically invisible in metric-driven evaluations. Insights generated through this process are intended to inform subsequent design iterations, including prototyping and evaluative studies, once concrete design directions have been articulated.

4 Workshop frame

In this section, we describe the workshop frame with which we conducted the introduced method and report a first session with a group of experts.

The workshop frame is structured as follows: first, a briefing about the intended XR interaction is given. Then, one participant takes on the role of the immersed user, and all other participants are given role cards. In the following 10-minute role-play, participants are invited to enter the scene and act according to the task on their role card while the facilitators observe and take notes. Subsequently, the group will discuss their observations and experiences, followed by an idea-generating session.

Duration	Phase	Instruction	Material
5 min	1 – Introduction	Facilitators outline the workshop format	VR-Headset

10 min	<i>2 – Role-play</i>	<i>One person immerses in an XR game and opens the scene. Others are invited to join, one at a time, after receiving their role card. Facilitators observe and take notes</i>	<i>Sticky notes, pens, role cards</i>
15 min	<i>3 – Group discussion</i>	<i>The group exchanges experiences and observations. Facilitators take notes, ask questions and moderate the discussion.</i>	<i>Sticky notes, pens</i>
15 min	<i>4 – Observations and Design articulations</i>	<i>Building on the insights from the group discussion, the group generates ideas for design articulations.</i>	<i>Sticky notes, pens</i>
Suggested follow-up:			
15 min	<i>5 – Prototyping</i>	<i>Paper-prototyping of the design articulations. Participants are invited to design the area of play or create tangible objects in pairs.</i>	<i>Tape, scissors, Cardboard, paper</i>
10 min	<i>6 – Presentation</i>	<i>Participants are invited to present their design suggestion.</i>	<i>Prototypes</i>

Table 1: Timeline of the workshop frame including suggested follow-up Prototyping.

4.1 A Real-World Test

The method was tested as part of a 45-minute workshop that was held in the context of a closeness technology network conference. Eight participants, all of whom were researchers or practitioners in the field of closeness technologies, took part and were supported by two facilitators.

The participants alternated between the role of the XR user and various roles representing external stakeholders. These included roommates, children, partners, pets, and delivery workers. To facilitate this, each participant received a playfully designed role card (Fig.3) describing a plausible everyday situation. The XR user, engaged in an immersive, fast-paced table tennis game, was unaware of the specific roles assigned to the fellow participants. We believe that this is one of the core strengths of the method: it is designed to elicit spontaneous, unscripted reactions and interactions, which XR interactions, embedded in everyday real life, should consider.



Figure 3: The role cards used to conduct the method representing a variety of potential stakeholders. (source: author)

4.2 Findings

The performative nature of the scenario encouraged participants to physically and emotionally inhabit their roles. Taking the role of external stakeholders, they initiated interactions based on their role’s objectives, while the XR user remained focused on the immersive task. Participants often exaggerated gestures, movements, and vocal expressions, making frictions visible that may otherwise have remained unobserved.

Participants reported and enacted subtle dynamics, which may have been difficult to capture through interviews or surveys alone such as hesitations, micro-movements, and unintended signals.

4.3 Group Discussion

Following the scenario play, participants engaged in a facilitated group discussion. They talked about emotional reactions, communication difficulties, and moments of misunderstanding or disconnection. The facilitators documented the discussion and clustered topics, highlighting recurring patterns and critical moments which informed the synthesis presented in the following section.

4.4 Observations and Design Articulations

The participants experiences and observations from the co-design session are organized around three perspectives: the immersed user, the experience of perceiving outward from within the immersive space, and the viewpoint of stakeholders in the physical environment.

4.4.1 In the Immersive Digital Space

How does the immersed user feel? What would they like to share, and how can they imagine inviting someone into their experience?

In our workshop frame, participants expressed a strong desire to share their experience with others. Feelings of isolation and frustration emerged when the richness of the virtual environment remained inaccessible to bystanders. This limited the perceived social value of the experience and raised questions about how shared presence might be supported in immersive contexts.

4.4.2 From the Digital Space Looking Out

What distractions do the immersed users perceive? How do they perceive the “outside world”? What makes them feel safe?

Our participants described a disorienting effect when attempting to respond to the physical environment while remaining engaged in the digital one. External actors were often perceived as abstract or unpredictable, highlighting a fundamental tension between immersion and situational awareness (Endsley, 1995), particularly in shared or semi-public spaces.

4.4.3 From the Physical Space

How do the stakeholders feel in their role? How did they perceive the immersed user?

Participants acting as external stakeholders experienced difficulties initiating communication with the XR user in our test. The absence of eye contact, facial expression, and legible body language created ambiguity regarding attention and availability, often leading to feelings of being ignored. Concerns about physical safety further highlighted asymmetries of awareness and agency between immersed users and those around them.

4.5 Design Articulations as Method Output

Rather than converging on concrete interface solutions, the post-session discussion produced a set of design articulations through which participants made sense of the frictions encountered during the scenario play.

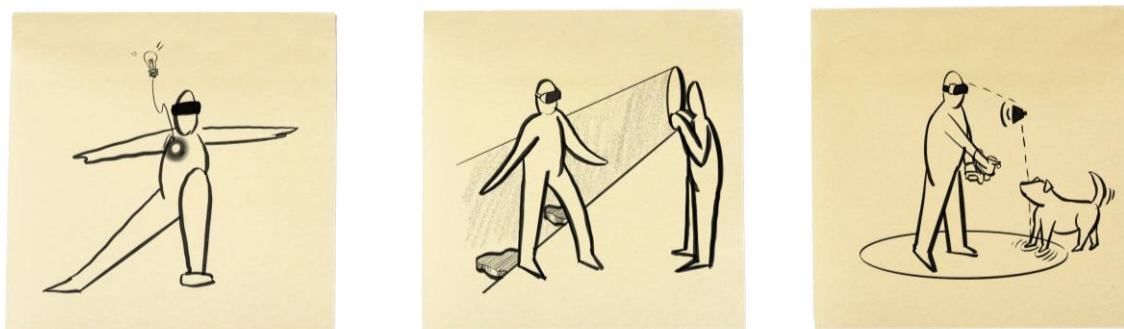


Figure 4: Some visualisations of the participants’ design articulations as result of the applied method. (source: author)

The design articulations in our case varied from “peepholes” into the immersive experience (Fig. 4, middle), ambient signals indicating availability (Fig.4, left), or ambient signals when other stakeholders enter the digital periphery (Fig 4, right). Across discussions, participants negotiated trade-offs including visibility versus privacy, ambient awareness versus interruption, and safety versus immersion.

The value of these design articulations as methodological artifacts lies in their capacity to externalize assumptions about responsibility, availability, and co-presence. The method helps designers identify what must be decided or contested in the digital periphery before specific interfaces or implementations are defined.

5 Discussion

The presented method surfaced valuable insights into how the digital periphery of immersive XR applications should be designed, so that it remains compatible with every day, socially and spatially embedded life.

However, the contribution of the method lies in how these dynamics are collectively enacted, experienced, and negotiated, rather than merely described. What is often treated as an abstract problem becomes a lived situation that designers can meaningfully work with.

By foregrounding peripheral experiences, this method contributes to broader debates on responsible and pluralistic design in post-immersive contexts.

Importantly, the method positions participants not merely as test subjects, but as co-theorists whose experiential insights carry conceptual weight. Meaningful XR design, from this perspective, must grapple with sociality, visibility, and friction as inherent aspects of interaction.

The ethical dimension turned out to be bigger than expected: interruptability, acceptance of ‘not seeing the same’, responsibility for safety, asymmetries of experiences, invisible exclusion, loss of eye contact, attention drain – these topics were raised, but exploring them will need to be left for future research in this area.

Across all workshop activities, the central challenge was not the XR experience itself, but the asymmetry between what immersed users and surrounding stakeholders could perceive, understand, and influence. We argue that this asymmetry constitutes the core characteristic of the digital periphery and distinguishes it as a design concern.

6 Limitations

The findings noted above need to be seen in the light of some limitations that our method entails – future research will be required to remedy this. Firstly, the participants in our workshop were all experts: laypeople could have varying experiences with the proposed workshop format. Second, we conducted only one single workshop, whereas a long-term, ‘focus group’ style workshop series may yield different findings. Third, we did not formally evaluate the resulting designs, which limits our ability to answer the question of whether or not the workshop led to a ‘better’ design. Fourth, we did not take user age, cultural backgrounds or other demographic details into account, which are likely to affect the tensions experienced (or not experienced) by the participants. Lastly, a playful approach as we propose it may lead to exaggerated reactions by the users, which could also affect the reported emotionality of the tensions. Consequently, the findings should be understood as exploratory and hypothesis-generating rather than representative.

7 Conclusion

This paper has introduced the concept of the digital periphery as well as a scenario-based, embodied co-design method for exploring the digital periphery of immersive XR experiences and gathering insights into design-relevant tensions and opportunities. By simulating everyday interactions, the method enables designers to surface moments of friction, misalignment, and ethical tension early in the design process.

The digital periphery emerges not as a limitation, but as a rich design space for reconsidering communication, safety, and co-presence. Making the invisible visible is not simply a matter of interface design but of rethinking the assumptions that structure immersive systems and their relationship to shared physical and social space.

The proposed method offers a playful yet critical way of engaging with these challenges through embodied exploration and collective sense-making. As XR continues to shape how we play, work, and relate, such approaches are essential for designing immersive futures that are inclusive, accountable, and socially attuned.

We increasingly interact in the overlap zones of physical and digital worlds – but their compatibility is not something we can take for granted. Making the design of these intersections easier and more human-focused is therefore a worthwhile goal that we want to contribute to with this method and encourage further research on. XR use is embraced not as an isolated activity, but as one embedded in everyday relationships, expectations, and constraints.

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Figure 1–4 are courtesy of the author.

Designing the Digital Periphery of Immersive Experiences

Workshop Framework (printout)

*This workshop-framework for designers and multidisciplinary teams offers a playful ethical exploration of the challenges within the digital periphery of immersive experiences at an **pre-solution stage of the design process** through a **scenario-based embodied co-design method**. In preparation of the workshop, print out the attached role card according to the number of participants and install a low-involvement game on the VR-Headset (e.g. VR-Tabletoptennis). We used the following list of potential stakeholders: pet, child, mailwoman, pizzadelivery, parent, roommate, partner (see fig. 3). For more infos go to (left blank intentionally).*

Duration	Phase	Instruction	Material
5 min	1 Introduction	outline the workshop format, set up the VR-game	VR-Headset, game
10 min	2 Role-play	Player immerses in XR game and opens the scene. Others receive role cards and join, one at a time, facilitators observe and take notes	VR-Headset, game, Post-its, pens, role cards
15 min	3 Group discussion	Exchanges experiences and observations. Facilitators take notes, moderate the discussion and ask questions. We suggest explicitly posing questions to explore the three perspectives participants experienced: In the Immersive Digital Space: <i>How does the immersed user feel? What would they like to share, and how might they imagine inviting someone into their experience?</i> From the Digital Space Looking Out: <i>What distractions do immersed users perceive? How do they perceive the 'outside world'? What makes them feel safe?</i> From the Physical Space: <i>How do stakeholders feel in their role? How do they perceive the immersed user?</i>	Post-its, pens
15 min	4 Observations and Design articulations	Building on the insights from the group discussion, the group generates ideas for design articulations.	Post-its, pens
Suggested follow-up:			
15 min	5 Prototyping	Paper-prototyping of the design articulations. Participants are invited to design the area of play or create tangible objects in pairs.	Tape, scissors, cardboard/paper
10 min	6 Presentation	Participants are invited to present their design suggestion.	Prototypes

your role

sketch your observations here.
What key moments did you witness?

source: [REDACTED]