ImmPres: Exploring the Potential of Mixed Reality Presentations in Real-world Office Settings

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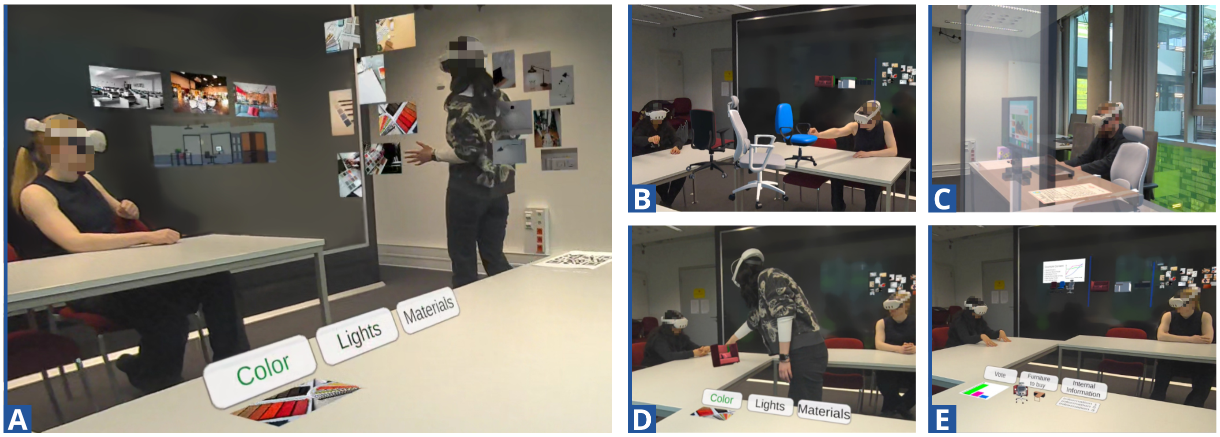

Figure 1: Envisioning presentations in MR: **(A)** Highlighting shared content (top right) based on presenter position, and associated personal content (bottom center); **(B)** Individual audience exploration of 3D models during the presentation; **(C)** Augmentation of the environment with an office design for audience immersion; **(D)** Ad-hoc content placement of a 3D furniture model (red couch) with associated highlights in personal view (bottom); **(E)** Individualized view showing content to one audience member (bottom).

Abstract

Mixed Reality (MR) can potentially transform workplace presentations and enhance knowledge sharing in office environments. Traditional slide-based presentation tools often constrain presentations to linear, screen-bound structures, which limit spatial exploration, audience engagement, and personalization. In contrast, MR supports three-dimensional content, augmenting real environments, and personalized views. We envision a future where MR presentations become a central medium for our workplaces. To systematically explore this potential, we conducted an expert workshop with MR and presentation specialists, including lecturers. Through thematic analysis, we identified key design aspects for creating MR presentations, including spatial content distribution, audience interaction, and maintaining narrative cohesion. Additionally, we demonstrate their use through an exemplified scenario of designing an MR presentation, illustrated by an implemented prototype. With the discussion of challenges and opportunities, we hope to lay the foundations for integrating MR into office presentations, reimagining how stories and ideas can be shared in professional settings.

Keywords: Mixed Reality, Presentation, Immersive Office, Narrative.

1 Introduction

Recent advances have made Mixed Reality (MR) head-mounted display (HMDs) more compact, capable, and accessible. As this trend continues, we envision MR becoming increasingly integrated into office work, enhancing knowledge transfer practices such as presentations, which are already central to workplace communication. Generally, presentations are widely used in varying contexts, such as lectures, conference talks, keynotes, or meetings. Furthermore, a wide range of advisory books on them exists, and research on several related subjects, like the relation between the audience, the presenter, the content to convey, and the media used, has been conducted [2]. Today, digital presentations have become mainstream, as seen in a range of traditional applications on desktops and even mobile devices. Classical tools like Microsoft PowerPoint[1], Apple Keynote[2], or Google Slides[3] focus on linear presentation on a slide-by-slide basis. Contrary, more recent tools like Fly [40], Prezi [34] or Focusky[4] provide a non-linear narrative through a canvas-based, zoomable interface, enabling interactive experiences and branching narrative paths.

However, current presentations are largely limited to 2D content and a single canvas with constrained real estate. This adherence to a screen also prevents integration of the real-world environment and surroundings, leading to limited flexibility in positioning content, audience, and presenters. Typically, this results in a setup where the content is on one side, the audience on the opposing side, and the presenter in between. Additionally, the shared single view prevents showing individual content to different audience members, and direct audience interaction with the content is limited due to the lack of personal input devices across the audience.

We envision the usage of Mixed Reality technology to overcome these shortcomings. Initial research on how to use immersive technologies in the context of presentations has already been conducted. It highlights the potential of more flexible positioning of content and presenter [30], direct manipulation of content [61], audience engagement [20], and the use of large immersive scenes as well as distributed personal views [3]. This research mostly focused on specific aspects of MR presentations, such as specific technologies involved to allow novel content-presenter relations and content manipulation [30, 61] or specific use cases, such as symmetric and

[1]https://www.microsoft.com/microsoft-365/powerpoint
[2]https://www.apple.com/keynote/
[3]https://workspace.google.com/intl/de/products/slides/
[4]https://focusky.com/

asymmetric presenter modalities [21].

To our knowledge, a deeper exploration of MR presentation aspects and their differences from non-MR presentations has not been done so far, and designers still lack insight into their creation. To address this gap, we explore presentations in a small-scale office setting. We opted for this setting, as small-scale office presentations are common for meetings and day-to-day office life.

Aiming to deepen the understanding of these topics and to collect concepts for their usage, we conducted expert ideation workshops in several simulated meeting room settings. We recruited 16 experts from either the field of MR or communication, presentation, or teaching. In each workshop, four experts ideated concepts of two MR presentations with pre-selected material in a co-located, shared, interactive environment.

We analyzed the ideas proposed in the workshop through thematic analysis, identifying ten primary design aspects of MR presentation. We further organized these aspects into four categories: script and pacing, stage and spatial setup, cast and participation, and spotlight. They provide a holistic overview and a structured vocabulary to characterize the essential and unique attributes in MR presentation. We then demonstrate how these aspects can inform the creation of MR presentations by describing a scenario and implementing the resulting presentation (see Fig. 1). Based on this practice, we discuss design implications as well as the challenges and opportunities of MR presentations.

In short, our main contributions are:

- An expert ideation workshop exploring new opportunities and concepts for MR presentation,
- Ten design aspects for MR presentations, including presentation structure, improvisation, and individualization, derived through thematic analysis of the workshop results,
- A scenario and prototype illustrating the design and feasibility of MR presentations, followed by a discussion of their challenges and opportunities.

2 Related Work

Our work explores how MR devices can support and enable presentations in office settings. We therefore review prior work on presentations and tools in traditional media (Sec. 2.1), summarize the state of the art of immersive collaboration and presentation (Sec. 2.2), and discuss related work on narrative techniques (Sec. 2.3).

2.1 Traditional Presentations and Tools

Presentations convey information, concepts, and arguments. They have already been a topic of research for several decades. For example, Arens et al. [2] explored the relation between audience, presenter, and content in the context of multimedia presentations. Regarding the used media, its type (e.g., visual, audible, haptic [6]), how information is transported, and how persistent the media is are also important to consider [1]. As a presentation is always meant for other people, it is crucial to consider human factors such as sensory processing, perception, and working memory [9] during the design and planning of presentations. Overall, several principles (e.g., [33, 52]) were proposed to enable the creation of effective presentations, like accounting for the presentation means and conditions (i.e., physical and situational environment), considering the addressee's physical and cognitive abilities (i.e., human factors), or combining different information types.

For slide-based presentations, the design perspective was also investigated, for example, showing that a focus on visuals rather than text increased student satisfaction [28]. Additionally, actionable guidelines for slide design [13] and increasing the effectiveness of presentations [76] have been proposed. Recently, automatic systems for slide design evaluation and presentation feedback have been developed to guide users through presentation creation [78, 80].

Tools for creating presentations have also been further developed, as presentations became more digital through Microsoft PowerPoint[1] in the late 80s. Still, the creation of the presentation's actual content was often done via tools tailored to specific task requirements [28]. Over the years, tools that facilitate the inclusion of multimedia content [26] and alternative presentation applications, such as Apple Keynote[2], have been published. These adhere to a linear, slide-based approach and include features like speaker notes, multimedia support, animation and transitions, as well as audience engagement tools like Q&A integration and polling. Next, multiple tools for integrating zoomable canvases into presentations were proposed, enabling the exploration of mind-map-like and non-linear narratives [34, 40]. Even though they were still confined to the shared view within the 2D display area, they overcame some of the slide's spatial limitations. MR presentations can push this even further by moving beyond the 2D plane through the inclusion of 3D content spatially distributed throughout the environment and by enabling personal views.

2.2 Immersive Collaboration & Presentation

Both Augmented (AR) and Virtual Reality (VR) offer opportunities for immersive collaboration and presentations besides their fundamental differences [56]. Since VR does not allow users to see each other without avatars, its concepts can be a base, but can't be directly transferred to AR. Research already focused on collaboration and multi-user aspects [31, 32, 53, 55, 65], which are both relevant to presentations as they also involve varying groups of people, as well as video-based [39, 61, 69] and remote presentation systems [70]. However, the current research still lacks specific literature for co-located MR presentations. Looking in the existing literature shows interest in whose view gets augmented, either the presenters [72, 79], the audiences [3, 30, 54, 70], or both at the same time [19, 21]. Another important topic is the immediate environments usage, either for general content placement [16, 75], for immersive analytics [46], or in collaborative scenarios [44, 77]. Regarding presentations, content is often shown in the direct vicinity of the presenter [30, 50, 69], close to walls [39], ceilings [3], or on objects like tables [21]. The scale of presentation environments (i.e., from 1-to-1 meetings [21] to lecture halls [3]) and the relation between the virtual content and physical environment, including people [24], are also necessary to consider. Lastly, regarding the control of presentation content, researchers have investigated gestures [50, 69], combinations of audio and gestures [39], and input devices such as pens [54].

Generally, immersive presentations can help to keep audiences engaged with the presentation's content [30, 54] and help the presenter to adapt content on the fly due to continuous audience feedback [79]. However, to systematically achieve this, a holistic understanding of how the space or the relation between the presenter, audience, virtual content, and real-world environment should be used is still needed.

2.3 Immersive Narrative and Attention Guiding

Like any presentation, MR presentations aim to communicate specific information from one person to another. This makes adjacent research areas that address information transfer, such as immersive collaboration, analytics, and storytelling also worth considering. Immersive storytelling [47, 66] extends conventional narrative techniques [10, 63] focused on narration, data, and user, by also incorporating the space, i.e., the physical, real-world environment, in which the narration takes place. Generally, immersive presentations create a more *"intuitive, engaging and expressive [...] storytelling through cohesive integration of physical and digital elements"* [69]. Specific locations [41], areas [44, 62] (e.g., pillars, whiteboards), or movable, physical artifacts [8, 43] within the environment can facilitate presentation narration and recall of previous topics [42]. The coupling of virtual content to the real-world environment and its artifacts, like seen in situated analytics [16, 17] or situated [36] and embedded visualization [75] facilitates attention guiding, which is important in immersive environments, since the virtual content is spread through the distracting real-world surroundings. To make the audience aware of already visible content or of changes within the same, adjusting color [14], using animations [45], or introducing additional visual indicators [25] are possible. The latter also facilitates guiding the view of the audience to places outside their current focus, i.e., to out-of-view content. For that, arrows, halos, or paths can be used [58, 74], whereof arrows and 3D bézier curves are most promising [74]. Furthermore, attention guiding can also be achieved through the presenter via, e.g., deictic gestures [23, 50]. However, guidance based on other users' gestures requires a common frame of reference. As this is not always the case in immersive environments, techniques to mimic or translate such gestures have been developed, including pointing avatar clones [70] and copies of users' hands adjusted to the target's reference frame [22].

Distributing content throughout the environment for narrative use introduces challenges such as differing user perspectives and occlusion. Virtual object placement has been widely studied [60], focusing on realism [51, 59] and occlusion prevention [15, 73]. The latter is especially important for presentations, where both the content and presenter should remain visible to the entire audience. These techniques mainly address occlusion caused by real-world entities, such as the presenter or audience members, but can also mitigate occlusion from virtual content. Visibility can also be improved through view sharing [37], which gives users the same perspective despite being in different positions [11, 71], or through perspective adaptation [38]. However, in co-located settings, these approaches can cause misaligned reference frames and pointing errors. Proposed fixes include virtual hand copies [22] or avatar distortions [18, 68] to match pointing targets across views.

Using user-specific virtual world rendering enables the creation of personal and private views. These views can show content tailored to individual needs and tasks [35], adjust details of shared views [64], and hide personal information from others [5]. Such views have been explored in collaboration around tabletops [29], in front of large displays [57], and in fully virtual environments [48]. For MR presentations, personal views could be used for similar goals. Generally, a private view was seen as beneficial for individual work [35, 54] while a shared view creates a common awareness [35].

Overall, in MR presentations, it is important to consider not only the above topics in isolation, but also how they interact in this immersive, multi-user, co-located context.

3 Key Components of MR Presentations

Discussing MR presentations requires a shared understanding of the external factors that influence and frame them. In the following, we briefly describe our understanding of these factors, resulting in the key components: *environment*, *users*, *content*, and *configuration*.

We characterize the **environment** through three aspects: the *room layout*, the *surroundings*, and available *artifacts*. The *room layout* describes how the furniture for users is positioned within the room. *Surroundings* encompasses all furniture not occupied by users (e.g., cupboards, shelves) and the architectural structure (e.g., walls, doors, pillars). Together with the *room layout*, this defines the static content placement space. *Artifacts* are available objects that are easily movable, to which content can be attached and moved together with the artifact, defining the dynamic space for content placement.

We understand all involved people as **users**, characterized by their *role* and their *mobility*. The *role* can be either presenter or audience member, as in classic presentations. The *mobility* describes how much the users can move through the available space.

We describe **content** as having five main properties: *media type* and *placement* describe which type of content (2D, 3D & static, animated) is placed where, while *visibility* and *interactability* describe which users can see and interact with the content. Additionally, *coordination* describes how, if at all, the content influences or is influenced by other content.

Together, the three components – **environment**, **user**, **content** – and their spatial relation form the configuration that frames an MR presentation.

4 Expert Ideation Workshop

We conducted an expert ideation workshop across four sessions[5] to (1) explore MR presentations in general settings, (2) derive insights into immersive presentations, and (3) how they differ from non-immersive ones.

4.1 Design and Rationale

We envision that immersive technologies will enhance future presentations by supporting both intrinsically 3D spatial content and 2D content arranged in space. As a first step, we examine how immersive systems can elevate key narrative aspects such as transitions, content placement, and presenter guidance in a familiar office meeting context. We created four physical environments through varied room layouts and audience positions (see Fig. 2 & Fig. 3) to cover a broad range of daily scenarios. Each environment was used by a single set of participants, covering two presentation topics: one emphasizing 3D spatial objects as content, and the other centered on 2D text and image content. This resulted in four workshop sessions. In each session, participants were split into two groups, presenter and audience, swapping roles between topics.We adopted a bodystorming-inspired approach [49] by placing participants in a mixed reality environment close to the target setting, providing concrete stories and materials, and letting them act out their ideas to deepen their understanding of the domain. We ran a pilot workshop (N=4) to validate the structure and refine instructions.

4.2 Participants

We recruited 16 experts (9 female, 7 male) via email. Their mean age was 32 years ($M = 31.75, SD = 5.77$). To diversify perspectives and stimulate creativity, we recruited eight experts in MR or immersive technologies (M1–8) and eight experts in communication, presentation, or lecturing (C1–8). Participants worked in related professional fields (at the local university and local educational institutes, exclusion of less than 2 years of experience) and had, on average, 6 years of experience ($M = 5.97, SD = 4.05$). Each participant received 40€ compensation.

4.3 Setup and Apparatus

To ensure study quality, we used commercially available software, FigminXR[6], on Meta Quest 3 in co-location mode. We prepared a custom scene for each topic. In all scenes, materials were arranged along the same wall. Each presentation part had a dedicated section with a heading (name and goal) and its assets, complemented by generic shapes (see Fig. 2). Participants used controllers and built-in tools to manipulate and duplicate assets and to sketch when needed. Additional audience members were represented by 3D head models placed on chairs or in a three-quarter circle for the furnitureless setup.

Workshop Environment The workshop environment was set up in a closed room where an area of ~4 m × 6 m was dedicated as the usable space for the participants. In this area, four different furniture arrangements were created, one for each session. These were: (1) A rectangular meeting table (2.4 m × 1.6 m) with ten

[5] Workshop documents, materials, an overview figure for relations between topics, environments and groups, and a procedure figure are in the supplementary material.

[6] https://overlaymr.com/home/

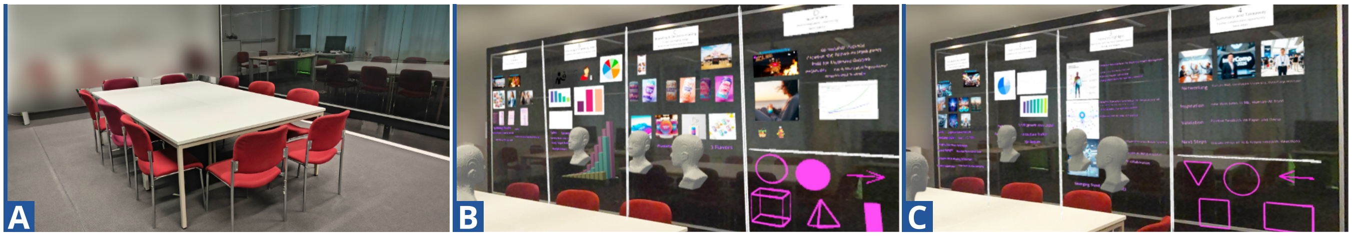

Figure 2: Layouts of session one: **(A)** no virtual content; **(B)** starting position of the content of the first presentation and **(C)** of the second presentation.

chairs distributed around all sides; (2) A lecture-hall-like setup with 9 chairs set up in 3 rows facing a singular direction; (3) A U-arrangement of three tables (1.6 m × 0.8 m each, 2.4 m × 2 m overall) with nine chairs distributed around the outer sides of the tables; (4) An empty room without furniture. For each setup, we predefined two audience positions (see Fig. 3, blue markings in room setups). Presenter positions were left open and determined by participants' narration. Two experimenters were present to moderate and observe, with one outside the workshop area for an overview and one in the area for additional direct support.

Presentation Material For each presentation topic, we provided a four-point storyboard, with each story point associated with a specific goal. For each point, participants received a curated set of virtual assets in the MR application. We generated the initial structure and assets using AI agents prompted with the topic, goals, and story outline[7]. The resulting materials included a topic-consistent structure and a diverse set of media (text, images, videos, visualizations, and 3D models), which we then refined for the workshop. We prepared two topics: (1) an internal discussion of a new sparkling-water product ("SpARkling Dreams"), and (2) a Ph.D. student's conference report for their lab.

4.4 Procedure and Presentation Ideation Task

Each workshop session consisted of five steps: (1) welcome and introduction; (2) consent form and pre-study questionnaire; (3) hardware/software training; (4) two presentation-ideation phases separated by a five-minute break and a role swap; (5) brief post-study interview for high level feedback. Each session lasted roughly 141 minutes on average.

After the first two steps, participants were asked to put on their HMDs and introduced to the software. For this, a simple, co-located scene was loaded, containing sample content of each type. Then, the participants were trained on how to interact with this content and the software in general until they had a clear understanding of it. For the ideation (step 4), two participants were assigned to the presenter and two to the audience roles, with one MR expert and one communication expert in each role. Presenters developed concepts for a five-minute, single-presenter MR presentation using the provided materials, while the audience provided feedback. After the break, participants repeated the ideation in the same furniture arrangement for the second topic, swapping roles (see Fig. 3) . Each phase lasted around 41 minutes (M=41:09 minutes, SD=4:57 minutes).

At the start of each phase in step 4, participants received the four story points with goals and associated materials and had three minutes to familiarize themselves with them. They then entered a shared MR scene. Presenters ideated sequentially from the first story point, while the audience gave feedback.We provided time reminders at 10 and 20 minutes. Two experimenters moderated to keep the discussion on track, probe for clarification, and involve quieter participants.

[7]Details of AI process and resulting assets are in the supplementary material.

Figure 3: Participant mapping to environment, roles, and topics. Participants were split across four sessions, each having one single environment. Mixed Reality experts (MRE) and communication experts (CE) were distributed equally. Between ideation phases, the audience and presenter roles assigned to the pairs were swapped.

After the ideation phases, a brief, semi-structured interview to collect high-level feedback was conducted. This was designed to collect general impressions, such as willingness to use immersive presentations or factors impeding adoption.

4.5 Data Collection and Analysis

We followed established practices for semi-structured qualitative studies [4] and provide additional details in the supplementary material.

We recorded the ideation process from participants' viewpoints using Meta Quest 3 headsets and captured the workshop space from two experimenter perspectives. Room audio, including the post-study interview, was recorded separately and complemented by semi-structured observation notes. To analyze the recordings, we synchronized the videos side by side in video-editing software, combining four participant views and two experimenter views. Supported by the observation notes, two authors identified and briefly described the proposed ideas, yielding 341 idea annotations, then exported these annotations as text snippets for further classification. Based on these annotations, three authors independently created thematic groups through thematic analysis [7] and then jointly refined and synthesized the final themes. Discrepancies were resolved by revisiting the videos until a shared understanding was reached. This process resulted in the ten design aspects.

Finally, we transcribed the post-study interviews and analyzed them for high-level feedback via thematic analysis by one author to identify more general perspectives on immersive presentations.

5 Results & Findings

We present the results of our thematic analysis of the ideation workshops, organized into ten design aspects. For each aspect, we also summarize the proposed ideas associated with them and concrete techniques that participants suggested for designing MR presentations (Sec. 5.1). In addition, we briefly report the results from the post-study interviews (Sec. 5.2).

5.1 Thematic Analysis

We organized the ten themes into four groups that reflect how MR presentations are conceived and experienced: Script and Pacing, Stage and Spatial setup, Cast and Participation, and Spotlight. They describe how MR presentations can leverage space to communicate narrative flow, configure shared and personal views, coordinate roles and interaction, and maintain audience attention. These design aspects are not intended to be exhaustive or prescriptive step-by-step guidance, but rather to provide a vocabulary for creating novel MR presentation experiences.

Script and Pacing We first describe four themes on **Structure**, **Unfolding**, **Transition**, and **Improvisation**. These themes regulate how the story progresses over time, regarding the order, how explicit it is, how the steps connect, and how much the presenter can influence it live.

Structuring STR describes how an immersive presentation conveys its overall visual structure and the connections between successive steps, for example, through a *timeline* or *headlines*. Participants proposed making temporal narrative flows explicit so that earlier content can be offloaded while remaining accessible. One approach was to move older material to peripheral physical walls or surfaces, using metaphors such as carousels, outlines, or miniatures, or to reduce it in size and shift it aside. Timelines that span walls, floors, or ceilings can also serve as spatial backbones, where current content expands when in focus and contracts while relocating to the periphery when out of focus. This balances attention between the ongoing storyline and its history. Finally, global textual headlines and titles, persistent central graphic elements (see Fig. 4B), and environmental anchors in the room were proposed to provide stable reference points and frame the presentation as a coherent whole, for example, hanging the conference name in question on the ceiling.

Unfolding UNF describes how successive narrative steps are visually connected and how content develops over time. Participants suggested several strategies to shape progression in MR presentations, including spatial movement, size changes, and on and off-stage dynamics. For example, narration can be synchronized with the presenter's walking path, where content panels appear sequentially along a route. In this case, the presenter naturally guides attention and indicates order, either by progressively revealing material while moving or by presenting content at once and using size changes to mark narrative shifts and highlight importance. Participants also described entry and exit dynamics to support unfolding. Triggered by buttons, gestures, or direct manipulation, elements such as text and images can appear stepwise, previous material can fade out or move aside, and new elements can grow from the floor or emerge into view to advance the story.

Transition TRA describes the fine-grained visual expression of change from one step to the next, reflecting how steps are connected. Multiple transitions can form a progression that supports unfolding. Participants proposed diverse transition techniques for immersive presentations, describing how content could appear, move, or disappear through fading effects, physical movement effects, and dramatic metaphors. Fading techniques ranged from the frequently mentioned simple disappearance to sliding or sweeping motions, as well as using the environment as a transitional layer to temporarily hide content behind walls, floors, or collages of tiled images. Physical effects included content emerging from or sinking into the environment, for example, popping out of tables, rising from below, or responding to gestures that trigger fade, rise, or fly motions. Finally, more expressive transitions included explosions or metaphors such as trash cans for discarding outdated material, turning transitions into narrative devices rather than simple switches.

Improvisation IMP describes how strictly the presenter adheres to a predefined order during an MR presentation. Our analysis revealed a spectrum of flexibility, ranging from *preset illustration* (where the order and position of elements are predefined), to *prepared illustration* (where either the order or position of elements is predefined), to *ad-hoc illustration* (where neither the order nor position is predefined), each offering different levels of control and spontaneity. Participants noted that preset assets, such as pre-recorded narrations or gesture-triggered animations, can reduce presenter effort but may limit flexibility and introduce occlusion. Prepared illustration builds on reusable components, such as augmentable charts or figures drawn from a library, with expansion, highlighting, and annotation used to guide attention. In comparison, ad-hoc authoring enables live annotations, on-the-fly content insertion, and real-time object manipulation or batch operations on grouped items, for example, pulling content "out of a pocket" and repositioning or reshaping it to emphasize specific parts. Finally, for creating content on the fly, participants called for alignment aids, such as snap-to-grid and auto-layout, to keep visuals organized.

Stage and Spatial Setup In this group, we describe the three themes on **Environment**, **Configuration**, and **Centralization**. These themes define where the presentation happens and how space is used as a resource.

Environment ENV describes the properties of the space in which the presentation takes place, including *augmenting the room*, *transforming the surroundings*, and *grounding artifacts in the target context*. In MR presentation, participants viewed the environment as a canvas for narration, for example, to reinforce messages through environmental cues or to provide a situated experience. One approach is to dynamically modulate the room's mood by adapting lighting, ambient colors, or music as the storyline progresses. Beyond mood changes, the environment itself can become a medium for immersion, such as transforming the room into a beach scene or surrounding the audience with 360° video. Finally, participants described situational augmentations that ground content in context. For instance, creating virtual shelves or a fridge to place cans can show how product packaging designs look in situ, providing a realistic backdrop that links abstract content to familiar everyday scenarios.

Configuration CON describes the spatial relation of content, presenter, and audience, situated within the environment. Participants' suggestions span a wide range of presenter positions relative to the content, including being behind the content, in front of it, alongside it (see Fig. 4A), embedded within the audience, mobile, or even invisible. Presenters may be tightly coupled to the content, standing in front of or beside key visuals as a gestural guide and annotator who directly manipulates visualizations. Alternatively, integration into the audience was proposed, for example, by sitting at a shared table or standing within a circular layout, to maximize visibility of the presented content. Mobility further extends these options, allowing presenters to move flexibly around or even behind the audience, with content following their gestures or adjusting to maintain readability. Participants pointed out that in some cases, presenters need not be visible at all, keeping attention entirely on the content.

Audience arrangement also shapes where and how content is

Figure 4: Techniques proposed by experts in our workshop: **(A)** Content configured at the front with the presenter beside it; **(B)** Structuring through a persistent graphical element, with a central image anchored to the table; **(C)** A personal copy to support audience engagement, allowing exploration of a 3D can model; **(D)** Content placed within the personal view of an individual audience member; **(E)** Participants highlighting the need for perspective correction for audience members using a central line chart; **(F)** Virtual content used as handout-like artefacts.

placed. During the workshop, we identified configurations in which the audience is arranged in circular or semicircular layouts, wall-facing layouts, or even covered by content, effectively making them invisible. Circular layouts support shared focus around a center, whereas wall-facing setups align the audience toward a single direction with the presenter positioned between them and the content. Finally, some participants imagined temporarily reducing or hiding audience representations to eliminate occlusion and enable cinema-like frontal configurations that can be toggled on demand.

Centralization CEN describes how presentation content is distributed across the audience, spanning a spectrum from *central* to *personal* to *mixture*, each with distinct trade-offs. A *central* placement was most commonly suggested by participants, where content appears at a shared central location, encouraging the audience to look in the same direction and establishing a common frame of reference. This mirrors classical presentations and can be achieved through spatial arrangements, such as a semicircle around a central display. Both 2D and 3D content can occupy this shared center, with 3D content optionally rotating to improve visibility.

By contrast, a *personal* distribution presents content so that each audience member has their own view in front of them. However, participants associated this with additional individualization (see Individualization). Additionally, participants suggested that presenters could pull content from a pocket into the scene and pass around photos or artifacts (see Fig. 4F), while synchronized highlights keep the audience aligned with the current explanation. While such arrangements can increase intimacy, engagement, and palpability, they may weaken shared grounding.

Finally, *mixtures* combines these approaches. Some content may be shared centrally, some may be shared centrally but perspectively corrected (see Fig. 4E), some may be shared with a subset of the audience, and other content may be distributed individually.

Cast and Participation We further describe the themes **Individualization** and **Audience Involvement**. These themes govern who gets what experience and who can do what.

Individualization IND describes how presentation content is synchronized across the audience, ranging from fully *synchronized* and identical views to *partly synchronized* or *individual* views for single audience members or subgroups. A key design consideration is maintaining presentation flow and presenter authority while enabling an appropriate level of individualization that can engage audience members more directly. This often requires coordinating central views with individual views (see Fig. 4D). Participants suggested, for instance, first introducing content in a shared central view and then handing it off to individual views, combining a large shared view that sets the context with smaller variants for closer inspection. Synchronization mechanisms such as cross-view highlighting and presenter proxies (e.g., laser pointing) were proposed to help maintain coherence across these views. In addition, individualization can also be supported through personal copies that do not need to remain synchronized, tailored highlights, or manipulable 3D object instances for private inspection. Such approaches can increase personal engagement, but they also introduce tension, as individualized exploration may conflict with shared group grounding.

Audience Involvement AUD describes the extent to which audience members can interact with presentation content, ranging from presenter-driven to audience-driven. It spans a *passive audience* (no interaction) to *audience inquiry on demand* (limited interaction) to *free exploration* (unrestricted interaction). Whereas many other design aspects emphasize presenter control, this theme highlights how audiences can actively engage through detail on demand, personal copies, opinion polling, and internalization, and it foregrounds the trade-offs these strategies introduce, especially the risk of disrupting structure and pacing.

Audience inquiry on demand lets audiences toggle elements and drill into deeper layers, but requires careful time management to avoid fragmented and unsynchronized exploration. Personal copies, such as content pulled into personal views or manipulable 3D objects (see Fig. 4C), were suggested for engagement. Polling activities, including voting or jointly selecting options, can highlight relevant content in shared and personal spaces to support collective judgments. Internalization can be supported through personal note-taking and reflection, for example, by annotating in personal space, copying content into notes, and synchronizing key elements back into shared summaries. A recurring concern of participants was that audiences should not interact independently unless explicitly permitted. When involvement is restricted, presenters should retain authority through clear visual cues such as locks and highlights that indicate when actions are available.

Spotlight We lastly describe **Attention Guiding**, a cross-cutting theme that supports all other design aspects by helping audiences shift focus to relevant content.

Attention Guiding ATT describes techniques that help the audience reorient their attention to specific content during a presentation.

We group these techniques into *highlight and contrast*, *gestures*, *symbols*, *animation*, and *annotation*. Participants frequently proposed visual emphasis, such as changing size, brightness, transparency, highlighting, or spatial prominence, for example, by moving content to the central stage. Attention direction through hand or body gestures, such as pointing to indicate the focus of interest or walking toward newly appearing content, was also suggested. Symbols, such as arrows or a laser pointer, were further ideas to pinpoint the elements relevant to the current narration. Animations, such as growing or rotating, were named to attract attention and sustain focus over time. Finally, annotation adds another layer of guidance. For instance, it was suggested that presenters can draw and annotate on central graphs, with synchronized reveals across personal views to keep the audience aligned with the elements relevant to the current narration.

5.2 Interview Results

During the brief interviews conducted at the end of the workshop sessions, participants expressed willingness to use MR presentations in the future and highlighted several potential benefits, including increased individual engagement, support for remote and mixed presence, and improved communication of topics that benefit from the displaying 3D spatial content that they rely on, such as medicine and criminology. They also noted opportunities in large-audience settings, such as classrooms with many students. Several favored ideas were highlighted, including personal views (*"I like the personalized paper in front of me."* [C6]), individual engagement, presentation history (*"I loved walking and sticking [content] to the wall for having a history"* [M1]), and spatial rendering of MR devices (*"3D content can be played in a focus area (personal view)"* [C1]). Participants further pointed out that two-dimensional materials can also benefit from spatial arrangements in the room, for instance, using a poster session metaphor [M4, C4]. At the same time, they discussed the trade-off of leveraging 3D and immersive content without overwhelming the audience [M3, C4] and reflected on audience mobility, which they viewed as highly dependent on the content but often effortful and distracting. Finally, some participants raised concerns about the effort required to author immersive presentations [M5, M6, C4, C6], as well as ergonomic and weight issues of current headsets [M3, M5, M7, C6].

6 Envisioning MR Presentations

In this section, we demonstrate how the previously described aspects shape MR presentation design through a scenario. To assess technical feasibility and implementation effort, and to experience the presentation firsthand, we implemented the scenario as an MR presentation (see video figure). The prototype supports co-located multi-user settings with roles such as presenter and audience to demonstrate the potential of immersive presentations in an exploratory way. It was implemented for the Meta Quest 3 with Unity, Meta XR SDKs[8], and Colibri [27] for additional network communication.

Anna, an interior designer, plans the presentation of an office design proposal using Mixed Reality. Based on the design aspects of MR presentations, she first analyzes the requirements and configuration space for her presentation, including the environment, users, and content to be presented. The planned *environment* is a medium-sized meeting room with tables arranged in a U-shape. The *audience* consists of around ten people, including client representatives and her colleagues. The *content* to present includes images, text, 3D models of furniture items, charts, and virtual scenes of the proposed office design rendered over the environment. Her design proposal includes an overview, requirements, and designs, and is structured as five parts of the presentation.

[8]https://developers.meta.com/horizon/documentation/unity/unity-sdks-overview/

Afterwards, she plans her general presentation approach, focusing on structure, improvisation, and unfolding, following the MR presentation design aspects. For the visual structure of the presentation (STR), she decides to communicate it by using a side area on the left wall for previous content, creating a timeline of the presentation, giving an overview to the audience at all times (see Fig. 7C). Anna plans to use pre-made content overall, but wants to leave some room for improvisation (IMP) within each part, giving her some freedom to adjust to the audience's reaction. To make the timeline structure work, she wants to use entry and exit dynamics for the presentation's unfolding (UNF), where old content moves to the left wall and shrinks, while new content appears. The transitions between the steps (TRA) for each part also follow entry and exit dynamics, including dis-/appearing, moving, and direct manipulation. She then plans each part of her presentation.

Part 1 - In the first part, Anna wants to introduce the general idea of the office design proposal, asking herself where to place the content (CON) and how to use the environment (ENV). She thus wants to let her introductory images appear step by step in close proximity to herself (see Fig. 5A), while standing in front of the audience, creating focus on the front and herself. To better communicate her ideas through the environment, she decides to transform the room by rendering a scene of the proposed office design over the environment at the end of this section, letting the audience feel as if they are in the office themselves, before the room reverts back and the content moves to the timeline.

Part 2 - To explain different requirements for the design in the next part, she wants to introduce a mood board with grouped images. To ensure focus on the currently explained group, she wants to guide the audience's attention (ATT) through highlighting it by increasing its scale and reducing the saturation of the other groups, while standing next to it. This adapts the content to her spatial position as she walks through the groups, emphasizing her connection to it. Additionally, she wants to provide each audience member with a handout of the requirement in their personal space on the table in front of them, allowing them to better follow along (CEN, see Fig. 1A & Fig. 5B-C). To transition to the next part, only the content in the shared space moves to the timeline, while the personal content stays.

Part 3 - In the next part, she wants to make use of the space for improvisation and plans to introduce specific furniture items. For this, she places small 3D models near her wrist, which are only visible to her. When she selects them, they become visible to everyone, and she can directly manipulate and place them, as if she were pulling them out of her pocket (see Fig. 1D). She can freely decide on the order and placement of these items, choosing the specific location ad hoc (CON), giving her flexibility to adjust to the audience. For each model, she explains how it meets the previously explained requirements. She decides to highlight the corresponding requirement both on the model in the shared space and in each audience member's individual handout from the previous part (CEN, see Fig. 6A), creating a clear connection across parts.

Part 4 - To keep the audience engaged in the next part, she wants to actively involve them (AUD). She thus wants to present three options for office chairs, placing them in the center of the U-shape. She plans to allow each audience member to grab any model from the center for individual exploration, resulting in a personal copy, invisible to others, that can be moved and rotated, allowing them to focus on personal interests. Concurrently, a line chart on the front wall shows the cost over time for each chair option. When an audience member interacts with a chair model, the corresponding line in the chart is highlighted for them (IND, see Fig. 1B & Fig. 6B-C), while the general information stays the same, resulting in a partly individual view. She also tells the audience members they can vote for their favorite option, which is then highlighted for them.

Part 5 - To conclude her presentation, she wants to provide a sum-

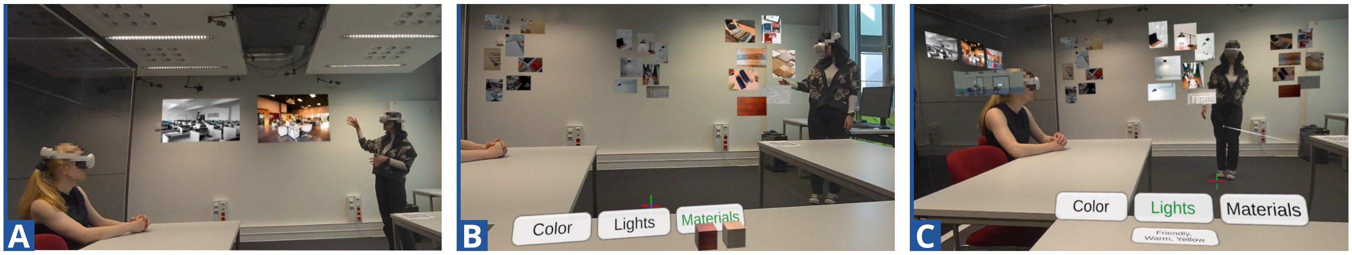

Figure 5: **(A)** Step-wise placement of content close to the presenter; **(B-C)** Depending on proximity to the content, the respective mood board gets highlighted, and the respective (text) section in the personal space receives a corresponding highlight.

Figure 6: **(A)** The presenter takes a furniture model out of their pocket and places it in the environment. While an object is selected, the appropriate part is highlighted in an audience member's personal space. **(B-C)** Audience exploration of models: when no model is selected, the line chart in front shows all lines equally. As soon as one object is interacted with, the respective line is highlighted in the chart.

mary in the individual spaces while she recaps the most important parts. The summary highlights the chair voted for and the results for the clients, and provides a brief version for her colleagues, focusing on the decision, thereby tailoring the summary to individuals (`IND`, see Fig. 1E & Fig. 7A-B), giving them the information most important for them. To involve the environment (`ENV`) for the final remarks, she reuses the office scene rendered over the environment from before, now including the chair model most people voted for (see Fig. 1C). With this, she hopes to leave a lasting impression of her proposal.

7 Limitations

We discuss the limitations of our work regarding the workshop design, presenter support, presentation location, and technology.

Workshop Design During the workshop, participants also proposed further application areas, such as medicine, criminology, or education, that could benefit from intrinsically three-dimensional visualizations. Since we focused on small group presentations in an office setting as a first step toward exploring MR presentation opportunities, the resulting design aspects may not cover all MR presentation formats, particularly lectures and keynotes with large audiences. For example, scaling audience involvement likely requires additional mechanisms to maintain presentation flow and sustain attention. Nevertheless, we believe the proposed concepts generalize to other settings, as they are not tailored to a single context.

Additionally, the workshop design included only a limited range of content types and styles, using specific examples of these types due to the defined presentation topics, which might have primed participants in certain directions. Still, we included types and styles present in 2D presentations and 3D content, benefiting from 3D environments, to support generalizability as much as possible. However, since presentations and their narrations are often highly dependent on specific content in practice, research of broader ranges of types and styles in different contexts would be beneficial.

Presenter Support Our findings provide concepts for how MR presentation can engage audiences. However, we do not explicitly address how to support presenters in authoring and delivering these presentations, particularly at runtime when managing and monitoring the flow. Compared to the limited display area of 2D presentations, distributing content throughout an environment can make it difficult for presenters to maintain an overview and to locate upcoming content. Even though some of the described techniques already include basic presenter support (e.g., structural overviews via a timeline), the design of dedicated presenter support tools remains an important future research direction.

Presentation Location The location where a presentation is designed may differ from the location where it is delivered, which creates the risk that presenters will need to prepare content without knowing the specific physical setup of the target environment. For traditional 2D presentations, the designed canvas is largely independent of the specifics of available display variations. MR presentations that integrate the environment are harder to transfer across environments and require dynamic adjustments. This could be done by using scene-understanding landmarks for positioning, but it only allows limited adjustments. Therefore, existing research on content adaptation [12, 67] and placement [44] needs to be evaluated for its applicability and expanded for the context of MR presentations.

The implementation of the scenario's presentation also highlighted the need for in-situ authoring tools, even if the target location is accessible. Because the presentation was created outside the environment and immersive context, the implementation required additional iteration loops to verify alignment and immersive functionality, increasing the time needed. Additionally, the programming requirements create barriers for non-experts and for day-to-day use, making the design of easy-to-use in-situ authoring tools a promising research direction.

Technology Participants highlighted ergonomic limitations of current HMDs, noting that prolonged wearing can be uncomfortable and fatiguing in longer sessions. They also pointed out that today's form factors occlude large parts of the wearer's face, which can hinder the perception of facial expressions and other subtle social cues. While these constraints shape the practicality of MR presentations today, we expect HMD technology to continue evolving toward greater comfort, improved balance and fit, and reduced visual occlusion, which may alleviate these issues over time.

8 Discussion

Building on the design aspects of MR presentations and our scenario demonstration, we identified opportunities and challenges for MR to expand communication beyond the confines of 2D slides.

Important directions of future work are the specific implementation of the design aspects, how the identified challenges can be addressed, and how the opportunities can be utilized. We have already provided examples of the implementation design aspects in our scenario; however, the specific implementation across contexts needs evaluation, as different contexts and specifics may call for different priorities. Nonetheless, the challenges and opportunities outlined in the following already describe realization options, identify resulting trade-offs, and highlight promising directions for further exploration of immersive presentations.

3D-Content Abstract and realistic 3D models, along with direct interaction with them, are unique to mixed reality presentations and were integral to many concepts proposed in the workshop. In contrast to 2D presentations, perspectives on content can differ considerably, and complex shapes can self-occlude each other from certain viewing angles. Several techniques were discussed during the workshop to counteract that, including but not limited to animated rotations, differently oriented duplicates, perspective correction, and audience interaction with the 3D objects.

Individualized Content One prominent feature of MR is its separate, personal displays, which can be tailored to each person and manipulated independently. Specifically, regulating this view with regard to its content and interaction creates potential for individualization and diversifies narrative experiences within a shared space. As described above, individualization was used in the workshops to mitigate visibility and perspective issues (e.g., with personal copies or perspective corrections). It was also used to adjust content based on user interactions, enable independent exploration, and display individualized summaries. This could be achieved with additional personal devices in non-immersive scenarios, but it would require significant overhead for the presentation setup, decreasing its viability.

However, while increasing audience agency, personal or individual views can also distract audience members, decrease the presenter's control, and lead to a loss of the common reference frame. Designers need to consider this trade-off and mitigate it by well-planned attention-guiding, limiting audience agency to where it is beneficial, and allowing the presenter to take back control when needed. Moreover, common references can also be restored, for example, by using an additional shared copy or adjusting pointers to the different views, such as using virtual copies of hands [22].

Mobility of Content and Users As MR presentations unlock the complete environment for content placement, users and content can also move around in the space more freely. Specifically, the presenter is much less bound to a specific position, as the content can easily follow the presenter, eliminating the need to move back to static content when discussing it. Increased user mobility also enables dynamic spatial configurations in which presenter placement reinforces narrative emphasis. For example, concepts using the presenter's position as an input for transitions were proposed. In this case, presenters interact with information in a more embodied and direct manner than 2D presentations. Such intuitiveness of interaction could allow for less dependence on pre-planned transitions, encourage the presenter to improvise the narrative, and engage with the audience on the fly. However, the increased user mobility was used less in the workshops' row-based and U-shape setups, where the presenter was mostly confined to an area at the front, probably due to legacy bias.

Environment Integration MR presentations can create a narrative structure by integrating the environment and landmarks. During the workshop, this resulted in several concepts in which not only the static environment (e.g., using walls for timelines) but also dynamic parts of the environment, such as artifacts and users themselves, were used as anchors for content. This allows using the audience's spatial memory and creating additional structural components without losing the main focal point's context, which is severely limited in 2D presentations.

Additionally, content can be spread out within the environment, a space that is not designed to allow easy visibility from every position in the room. Content in 2D presentations is fixed to a single, easily visible plane, but in MR presentations, content distribution can lead to occlusion due to architectural elements and users. This can be addressed through placement itself, but also through duplicated or personal views. Workshop participants often avoided those problems by returning 2D content to centrally visible planes. Still, they sometimes used duplication or personal views to regain some freedom in placement. We think this is partly due to the legacy bias toward 2D presentations, and that increased familiarity with MR presentations will lead to less plane-based content placement in the future. Utilizing spatial metaphors – such as revolving stages, plazas, or buildings – could be a good starting point for future investigation of better and more appropriate spatial arrangements.

Attention-guiding for spatially distributed content is vital, as there may not be a clear focus area, requiring clear guidance for the audience. In the workshops, several techniques were proposed to address this. They used visual emphasis, such as highlights or spatial prominence for larger structures, or symbols and pointers for smaller areas of interest. For 3D objects, animations were suggested to catch users' attention, similar to related work [14, 25]. Annotations that align with each user's perspective were discussed to solve the problem of differing reference frames, similar to existing approaches such as clones of hands [22] or whole avatars [70].

Atmosphere and Full Immersion In addition to 3D content and environment integration, MR also allows presenters to completely transform the presentation environment. As MR can diminish reality and replace real-world objects with virtual ones, the room can be transformed, in whole or in part, into any virtual scene. In contrast to traditional presentations, this can create a narrative connection between the presentation's content and the space occupied by the audience by "transporting" them to different settings, such as a beach or jungle. Future studies could examine whether this leads to a more embodied experience of the presentation and to higher audience immersion.

However, environmental transformation can also be disorienting for users and should therefore be announced beforehand, especially when sudden changes occur. As virtual content needs to occlude parts of the environment to transform it, real-world obstacles could be hidden. To prevent mobile users from colliding with such obstacles, some indication of their presence needs to be maintained in the virtual world. Large-scale virtual scenes can also occlude other audience members and the presenter, hindering effective interaction among users. This could be prevented by masking users, but this can reduce immersion, leading to a trade-off to be considered during the design.

9 Conclusion

Through expert ideation workshops, we explored how Mixed Reality can reshape everyday presentations. As the first step towards the vision, we focused on small-group presentations, which are prevalent in daily office settings. Based on the proposed techniques from the workshops, we identified ten essential design aspects for MR presentations via thematic analysis. These include: presentation structure, content configuration, the audience and the presenter, active audience involvement, and listener-specific individualization

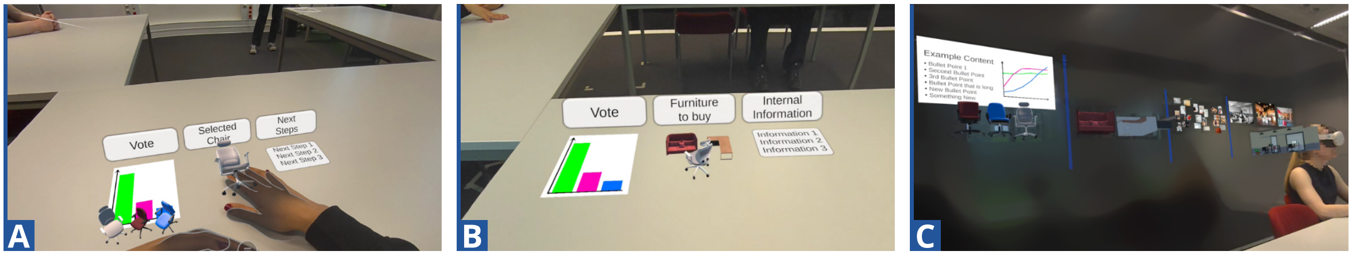

Figure 7: **(A-B)** Personal views in front of the audience. Each view shows different, individualized content. **(C)** Timeline structure showing the overview of the presentation.

and views. We demonstrated how these aspects facilitate the design of MR presentation through a scenario, and implemented the resulting presentation. This process also highlighted the need for in-situ authoring tools as future work. Reflecting on the design aspects and the scenario, we identified opportunities and challenges specific to MR presentations. With this, we hope to encourage the community to further explore the rich design space of MR presentations and to pave the way for integrating them into our future office life.

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