Sharing and Exchanging Realities through Video See-Through MR Headsets

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Abstract

Humans often have a natural inclination towards exploring and sharing and the intricacies of daily life. This paper explores concept ideas of using video see-through capable mixed reality (MR) headsets to enable individuals to share and receive content diverging from traditional media forms. We propose four ways of sharing personal realities, considering reciprocity levels and temporal factors, encompassing unidirectional, bidirectional, synchronous, and asynchronous sharing. We further elaborate on some use cases for each way. The paper also addresses ethical concerns arising from MR sharing, such as privacy issues, the allure of experiencing life through others, and the potential effects on one's sense of personal reality.

Keywords

Mixed Reality, Reality Sharing, Live-streaming

1. Introduction

Sharing personal lives and activities through technology has been researched in human-computer interaction (HCI). It ranges from sharing calendars to increase self-disclosure and intimacy [1] to sharing one's longing through a tangible device [2]. With the evolvement of technologies, sharing activities can also be supported in various ways. For instance, content sharing on social media has expanded to encompass a broader range of modalities, from text and images to short videos, through methods like blogging, Instagram Boomerangs and Reels. Besides, the shared content can be more engaging by adding creative tools such as camera filters. Additionally, in the current trend of live-streaming, the streamers and viewers are becoming more engaged in communicating with each other, and the viewers can influence the narrative directly [3], such as by instructing streamers during live interactions. Beyond modality enrichment, engagement, and interactivity, immersiveness could also gain more popularity in content sharing. For example, by utilising 360-degree video streaming technologies, users can view the shared content through a head-mounted display (HMD) in an immersive way [4]. Furthermore, objects can be live blended into 360 degree streamed video, making it more dynamic [5]. Nation et al. [6] found that, by watching a 360-degree immersive video in an educational setting, students have a higher satisfaction than watching a conventional video. Besides, the shared 360-degree panorama video can be enhanced by applying mixed

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Figure 1: An example of sharing realities through mixed reality technologies: On the left, a streamer broadcasts her travel experiences directly through the front camera on the MR headset, sharing her journey in real-time. On the right, viewers partake in an immersive travel adventure, experiencing the sights and sounds through the streamer's perspective, as if they are exploring the uncharted locations as well. Picture generated by DALL·E 3 [8].

reality (MR) technology. Lee et al. [7] enriched the video watching experience by overlaying MR visualisation of non-verbal communication cues, such as visualisation of view focus points and gesture cues. Besides 360-degree videos, volumetric video also enables the capture of vivid 3D content. However, its use case is often limited to capturing objects or people, making it challenging to share first-person perspective content from the streamers' views.

MR technologies, which offer the possibility of integrating virtual and physical realities and seamless transition between the two, can offer opportunities for novel experiences of sharing one's life and reality. Especially with video-see-through capable MR headsets, we expect that the sharing and viewing experiences could vary, as we see the world directly through the streamers' eyes. These experiences could potentially become more first-person-oriented, more personal, and closer. We are curious about how the ways of content sharing might be designed.

This paper provides concepts for sharing realities through video see-through capable MR headsets. It explores various ways of sharing MR contents, considering reciprocity levels and temporal factors that shape different forms of sharing, including unidirectional, bidirectional, synchronous and asynchronous sharing. These ways highlight the versatility and potential of MR in enhancing the richness and depth of shared experiences. Furthermore, we address the ethical implications arising from MR reality sharing. Privacy concerns, the allure of living through others' experiences, and the impact on personal reality are critical considerations. We aim to balance technological innovation with ethical responsibility by examining these facets.

2. Motivation and Background

The motivations of individuals who post their experiences or activities online have been researched by Stone et al. [9]. They found that people primarily share their personal experiences on social media for social reasons. This inclination towards sharing can be influenced by personality traits, with extraversion contributing to the sharing behaviours of personal life [9]. Furthermore, individuals experiencing loneliness or having lower self-esteem may utilise social media to share personal experiences for therapeutic reasons [9].

Sharing real-life experiences has also motivated technical development to support this process. Numerous previous works have investigated the role of technologies in fulfilling various sharing needs and the impacts of technology-enabled sharing activities. For example, Thayer et al. [1] found that calendar sharing is a way of achieving intimacy and self-disclosure. Through authoring event descriptions, users can express their emotions but also keep privacy by avoiding sensitive information. By practising calendar sharing, users can accomplish relational work. Neustaedter et al. [10] designed an "always-on video" system for sharing everyday life, supporting expressions of intimacy over distance and building connections. Chattopadhyay et al. [11] analysed vlogs of "a day in the life of software developers" and found that developers are inclined to share more non-coding related tasks, such as time spent with family. Olsson et al. [12] investigated the user needs to share life memories and found people value recollecting past events and milestones. Sharing common memories is a key factor in strengthening social ties and bonds.

Besides sharing, people also have multifaceted motivations of consuming the shared lives [13], which can be observed by the surged popularity of Day-In-The-Life videos [14]. Research shows that factors such as a sense of community, emotional support, and interactivity can positively affect viewers' social presence and, subsequently, their engagement with the streaming content [15]. Moreover, viewers are also appealed by the authenticity of the stories, they can resonate due to the genuine and relatable content or maybe also learn from the lives of others [14]. This often provides surprising and varied experiences that differ from their own lifestyles.

Building on the motivations behind humans engaging in reality sharing and receiving, as well as the technical enhancements facilitating this process, we believe that technologies such as video see-through MR headsets — which allow users to perceive the real world even while non-transparent displays cover their eyes — can open up new possibilities. These MR headsets are equipped with cameras mounted on them to capture the real world and stream it onto the built-in display. This capability forms the basis for broadcasting one's reality, experiencing someone else's reality, or exchanging realities between the two — users can send, receive, or swap their views with another user's see-through video feed via network connections for an immersive experience. However, the quality of the streamed videos may be limited by the resolution of the cameras, the fidelity of spatial and stereophonic sound, and potential delays caused by network connectivity and bandwidth constraints.

Yet, the concept of sharing content through an MR headset is not limited to sharing one's reality, but also extends to one's virtual reality or personalised reality. Strecker et al. [16] highlighted the motivations for sharing one's personalised reality, such as avoiding filter bubbles and increasing user's autonomy and control.

3. Concept

We categorise four different ways of sharing see-through video content, taking into account both directional and temporal factors. The sharing can be unidirectional or bidirectional, and it can occur in real-time (synchronously) or be accessed later (asynchronously). We further elaborate on some use cases for each way.

3.1. Unidirectional Sharing

Unidirectional sharing enables the streamer to live in and perceive their reality, while the viewer's perspective is completely replaced by this alternate reality through the headset. This form of interaction can take place between streamers and viewers on streaming platforms or among friends in private video chats. This mode of sharing is apt for everyday MR scenarios, where any aspect of daily life can become content for sharing (see Figure 1). Picture a scenario where your friend is relaxing in a café with a pleasant ambiance. They could share this pleasant experience with users and immerse one in a café through the MR see-through video. Similarly, streamers travelling to foreign countries can immerse their viewers in unique experiences. For example, they might try a salivating bowl of ramen and transmit this experience to their audience from a first-person perspective. In educational settings, streaming reality can foster empathy [17]. Teachers could adopt the perspectives of children, gaining deeper insight into their challenges and experiences. This empathetic approach can lead to more effective teaching strategies and a stronger teacher-children connection. Furthermore, unidirectional streaming method can open the door to novel experiences. Take a music enthusiast who has longed to know what it's like to be on stage with a band, performing in front of a vast audience, as an example. MR sharing technology can fulfil this dream by providing a complete immersion into the musician's viewpoint, allowing the fan to step into the shoes of a performer virtually.

However, even though this streaming method incorporates see-through video, and stereo audio, among others, creating a high-fidelity simulation that engages our visual, auditory, and potentially olfactory senses, it still faces challenges in achieving full body awareness. Research indicates that a mismatch between virtual locomotion and actual body movement can negatively impact user experiences [18]. This misalignment can lead to confusion, diminish the sense of body ownership, and reduce immersiveness. Moreover, without control over the viewpoint, cyber sickness could be induced [19]. To grant viewers direct control, the camera could be mounted on a robot, or, similar to the DJI FPV [20] system, where users remotely control the moving machine and the direction of the cameras, and view through goggles, to achieve full immersiveness. However, this requires the deployment of remote machines and could raise security (surveillance) and safety concerns. Kasahara et al. [21] proposed a first-person omnidirectional video system, utilising an omnidirectional camera and a goggle for capturing and reviewing first-person content to reduce motion sickness.

3.2. Bidirectional Sharing: Swapped Reality

Bidirectional streaming, unlike single directional streaming, replaces the realities of both parties, making it impossible to do independent activities. Therefore, bidirectional streaming is less

Figure 2: Inspired by the "ghost view" in Mario Kart [22], where a semi-transparent character from a previous video blends into the scene, we envisage the future of streamed video being able to be cropped and seamlessly embedded in situ into someone's reality. In this culinary scenario, users are enabled to live stream someone else's cooking processes in the immediate surrounding, allowing for real-time conversation and instruction sharing between them. Picture generated by DALL·E 3 [8].

suited for one-sided experience sharing and more apt for creating novel, fun, and creative experiences. For example, it can facilitate a body exchange simulation, allowing swapping realities. Such reality-swapping opens up unique and engaging opportunities, such as couples living in each other's bodies for empathy-building and relational bonding exercises. This experience can be enhanced by e.g. coordinating movements — such as synchronising hand touches — where participants align their actions with their video see-through view. This creates a mental match and the illusion of controlling the swapped body, thereby intensifying the sense of body ownership and agency.

Reality swapping can also facilitate engaging collaborative experiences and foster trust. Imagine a couple co-wandering in a forest, each seeing only through the other's eyes, unaware of their own immediate surroundings. In this scenario, trust and communication become essential, as each partner must rely on the other for guidance in an environment with obstacles. Such an experience could strengthen trust and empathy within the relationship.

However, it is still feasible for individuals to engage in their own activities during bidirectional sharing, when the videos are cropped and only partially blended into one's reality (see Figure 2). By enabling the blending of video segments from a sharing partner in a 3D hologram manner, a sense of co-presence can be attained even in the absence of physical co-location. This method can be applied for collaborative tasks, instructional scenarios, or for fostering intimate connections. Work from Grønbæk et al. [23] has partially blended dissimilar real-world environments into shared realities, creating a coherent blended space. Furthermore, Yoshino et al. [24] proposed the idea of blending the streamer themselves into the shared realities. However, this approach requires additional capturing cameras or pre-scanned full-body avatars, which adds more complexity than directly streaming through MR headsets.

3.3. Synchronous Sharing: Co-living in the Moment

Synchronous sharing through live-streaming opens up a realm of real-time interaction between viewers and streamers. This form of sharing transcends passive viewing, allowing for an active exchange where viewers can engage in live discussions and share immediate reactions. Furthermore, viewers can also influence the stream's storyline. For example, they might prompt streamers to explore specific scenarios or activities. This interactivity caters to a wider range of interests, enabling a more dynamic and engaging experience, and fostering a sense of co-living and shared experience.

3.4. Asynchronous Sharing: Memory Sharing

Asynchronous sharing allows for the preservation of streaming videos for future rewatching. This mode of sharing enables a "yesterday once more" experience, where individuals can relive past moments with high fidelity. Leveraging spatial computing, which can re-present past events with stereo video and audio, it makes users feel as if they are actually there. It's akin to replaying a memory, providing a high level of presence and authenticity. This extends the life of shared experiences beyond their initial occurrence.

4. Ethical Concerns

This section outlines a series of ethical implications associated with MR reality sharing, addressing concerns such as detachment from personal reality, privacy infringement, and the propensity to prefer memories over the present.

1) Others' Lives are Better - Detachment from Personal Reality: A potential risk of immersive experiences of other's life through MR is detachment from one's own reality. The zero-distance immersion in others' lives might lead some individuals to perceive others' experiences as more desirable, potentially causing a reluctance to engage with their own real-life situations.

2) Privacy Infringement: With mobile MR live-streaming becoming more prevalent, concerns about privacy infringement could rise. The possibility of unintentionally capturing and sharing the lives of bystanders calls for solutions like face-blurring technologies to protect the privacy of individuals who have not consented to be part of the shared experience.

3) Living in the Past: There is a risk that individuals may overly indulge in reliving memories, preferring the comfort of "yesterday once more" to facing present realities. This preference for memories over current experiences can lead to a disconnect from the present.

4) The Entire History of You: The capability to stream and store realities at any time raises concerns about consent and the compulsion to share memories. The ethical ramifications of having one's entire history potentially accessible and revisitable need to be thoroughly examined to protect individual autonomy and privacy.

5. Conclusion

This paper explored the transformative potential of video see-through capable MR technologies in reality sharing, highlighting how MR technologies can augment our experience of sharing and

consuming personal lives and activities. Through the lens of MR, we believe that unidirectional and bidirectional, synchronous and asynchronous modes of sharing have the potential to deepen our interactions, enrich our experiences, and extend the lifespan of our memories.

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