Passive Observation and Asynchronous Feedback to Mitigate Meeting Fatigue

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While facilitating remote collaboration, virtual meetings often lead to participant fatigue due to continuous engagement and cognitive overload. This paper proposes a hybrid Mixed Reality (MR) system that incorporates passive observation and asynchronous feedback to alleviate meeting fatigue. The system enables users to observe live VR meetings unobtrusively via non-VR devices and review recorded sessions at their convenience, providing structured feedback without the pressure of immediate response. This approach aims to reduce cognitive strain and enhance inclusivity, benefiting individuals who prefer reflective communication or are prone to fatigue during synchronous interactions.

CCS Concepts: • **Human-centered computing → Empirical studies in collaborative and social computing**.

Additional Key Words and Phrases: Passive Observation, Asynchronous Collaboration, Meeting Fatigue, Cognitive Overload, Distributed Collaboration

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1 Introduction

Distributed collaboration through Mixed Reality (MR) can significantly enhance remote interactions. Traditional MR collaboration is often synchronous, requiring simultaneous user presence, which can replicate face-to-face interaction but also introduces challenges. Synchronous MR meetings can cause cognitive overload and fatigue due to constant avatar management, awareness of observation, and limited non-verbal cues, a phenomenon widely recognized as "Zoom fatigue" [7, 9]. They may also disadvantage individuals who prefer reflective or written communication over immediate verbal participation [2, 10].

To address these issues, recent research suggests incorporating asynchronous elements in MR collaboration, enabling participants to engage at flexible times, thus reducing pressure and cognitive strain [3, 6]. Users can thus contribute comfortably through text or visual annotations at their convenience, reducing stress and fatigue [1, 11].

This paper proposes a hybrid MR system supporting passive observation and asynchronous feedback. Users can quietly observe live VR meetings from non-VR devices (e.g., desktop or smartphone), later review recorded sessions, and provide structured textual feedback without pressure for immediate responses. Our approach addresses meeting fatigue by combining real-time passive attendance with asynchronous input methods. It enhances inclusivity, particularly benefiting introverted users or those unable to participate actively in synchronous meetings.

2 Related Works

In exploring the domains of passive observation and asynchronous collaboration within Mixed Reality (MR) environments, we identify key studies that inform the development of systems aimed at mitigating meeting fatigue and accommodating diverse user preferences.

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2.1 Passive Observation

Passive observation allows users to experience virtual environments without active participation, benefiting individuals who prefer less immersive engagement or are new to VR. Fitton et al. demonstrated that observational learning in VR effectively promotes skill transfer, particularly when paired with hands-on practice, highlighting design considerations for passive interaction modes [4]. Luo et al. systematically explored experiential differences between active and passive users during multi-user locomotion, identifying significant psychological and physiological gaps, and suggesting improvements for passive-user experiences [8]. Similarly, Giovannelli et al. emphasized the importance of interactive playback during asynchronous VR tours, finding improved user experience and information retention when passive observers had control over their viewpoints during playback [5]. These insights collectively inform how passive observation can be integrated effectively into MR environments.

2.2 Asynchronous Collaboration

Asynchronous MR collaboration provides flexibility, allowing participants to contribute without immediate temporal constraints. Chow et al. highlighted challenges such as maintaining workspace awareness and coordinating multimodal communication among distributed collaborators, proposing design recommendations for intuitive and effective asynchronous VR systems [3]. Building on this, Irlitti et al. (2016) identified context-sharing and situational awareness as significant issues in asynchronous AR collaboration, emphasizing the need for deliberate system design to accommodate asynchronous interactions effectively [6]. Additionally, Zhang et al. presented "Virtual Triplets," an MR system integrating human-agent interaction to support seamless transitions between synchronous and asynchronous modes, significantly improving user engagement and continuous support [12].

Annotations and textual feedback have also been extensively researched in asynchronous collaborative contexts outside MR. Cadiz et al. provided foundational insights into the effectiveness of web annotations for asynchronous document collaboration, emphasizing their role in enabling structured communication and thoughtful participation [1]. Weng and Gennari further developed this notion, designing an activity-oriented annotation model to facilitate iterative, asynchronous collaborative writing, emphasizing enhanced in-situ communication and context awareness [11]. Such annotation-based strategies are crucial to the asynchronous feedback mechanism proposed in this paper, allowing MR participants to contribute comfortably and meaningfully.

These studies collectively inform the development of MR systems that incorporate passive observation and asynchronous collaboration features, aiming to create more inclusive and flexible environments that mitigate meeting fatigue and cater to diverse user preferences.

3 Proposed Solution

We propose a hybrid Mixed Reality (MR) meeting system that integrates real-time passive observation and asynchronous feedback mechanisms to accommodate diverse user preferences and mitigate meeting fatigue.

3.1 Technical Details

3.1.1 Real-Time Passive Observation. Users who cannot engage actively in immersive VR meetings can participate as passive observers using non-VR devices such as desktops, tablets, or smartphones. In this mode, avatars do not represent observers, minimizing distractions and maintaining unobtrusive participation.

The system streams the VR meeting in real-time to observers' devices, offering various perspectives, including immersive 3D or 360° views and selectable camera angles such as overhead or presenter views. To make passive observation engaging, observers have enhanced interactive features, such as the live text chat feature, which allows observers to take personal notes or quietly pose questions without disrupting the meeting. Observers can tag or annotate significant moments during live streams, creating instant reference points. For example, observers can highlight key interactions like disagreements, consensus-building, or pivotal decisions for later playback.

3.1.2 Asynchronous Meeting Recording and Feedback. All VR meetings are recorded, capturing avatar movements, voice transcripts, and shared visual content. These recordings are organized into interactive timelines for later review.

Users can access these recordings at their convenience through standard screens or VR and experience the meeting as if they were present. They can navigate through the timeline, focusing on key discussions or decisions.

During replay, users can provide feedback by attaching comments or questions to specific moments in the timeline. The team shares these annotations, creating an asynchronous discussion layer that original participants can review and address in subsequent meetings.

3.2 User Scenarios

3.2.1 Enterprise/Workplace Collaboration. A software development team conducts a weekly design review in VR. David, an engineer who finds back-to-back VR meetings exhausting, opts to join as a passive observer from his laptop. He watches the interactions and reviews 3D models without the pressure to participate actively. Later, he accesses the meeting recording, navigates to key discussions, and provides his input through comments and mock-ups. The team reviews his contributions in the next session, ensuring his ideas are considered without requiring real-time presence.

3.2.2 Educational Settings. In a university seminar held in VR, Alice, a student with social anxiety, chooses to observe the session passively on her tablet. She follows the lecture and discussions without the stress of active participation. Afterward, she reviews the recorded session, reflects on the content, and submits her thoughts and answers to discussion questions via the asynchronous feedback system. Her contributions are acknowledged in the subsequent class, allowing her to engage meaningfully at her own pace.

By integrating real-time passive observation and asynchronous feedback mechanisms, our system aims to reduce meeting fatigue and accommodate diverse communication preferences, fostering a more inclusive and flexible MR collaboration environment.

3.3 Evaluation Strategies

We propose a mixed-method evaluation involving both quantitative user studies and qualitative assessments. Quantitative studies will measure user fatigue levels, cognitive load (NASA-TLX), and perceived inclusivity and productivity across different modes of interaction (active VR, passive observation, asynchronous review). Qualitative data, collected through semi-structured interviews and thematic analysis, will explore subjective user experiences, engagement preferences, and suggested improvements to enhance the proposed system. This combined approach provides comprehensive insights into the system's effectiveness in mitigating meeting fatigue and improving user satisfaction.

4 Conclusion

The concept of integrating passive observation and asynchronous feedback into MR collaboration holds promise for creating more flexible and user-centric environments. By allowing participants to engage at their own pace and comfort level, such systems can mitigate common issues associated with synchronous interactions, like fatigue and cognitive overload. Future research should focus on the practical implementation of these features, assessing their impact on collaboration effectiveness, user satisfaction, and overall productivity.

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