Designing Mechanisms to Empower Attendees of Remote Meetings to Promote More Effective and Helpful Meetings

Gun Woo (Warren) Park
Department of Computer Science
University of Toronto
Toronto, Ontario, Canada
warren@dgp.toronto.edu

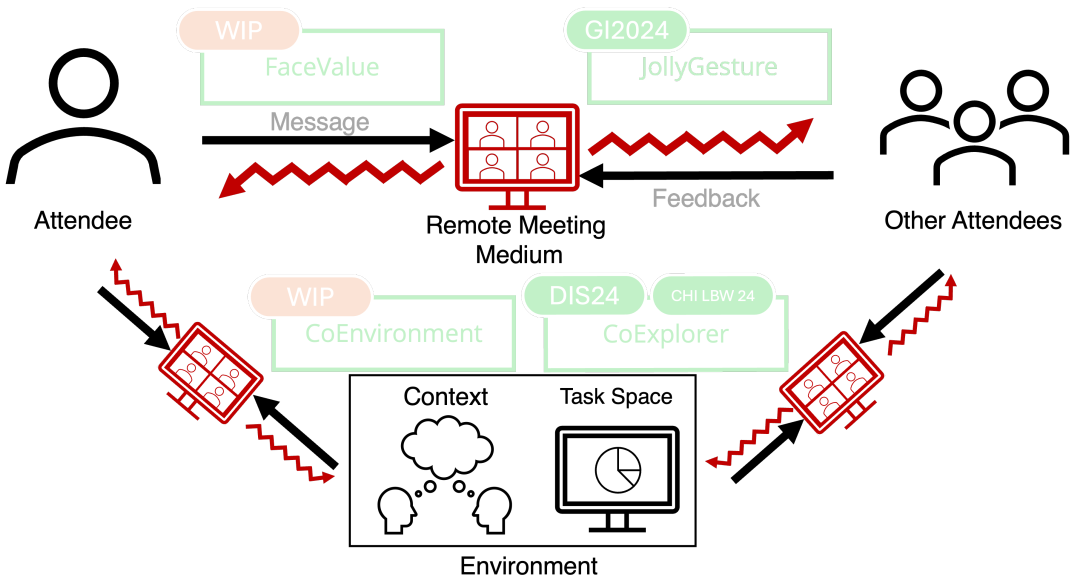

Figure 1: Meetings have three constituent elements: attendees, other attendees (from the perspective of an attendee), and the shared environment, shown as icons. Information flow and interaction between constituent elements in meetings are shown as arrows. Hindrances to communication caused by the remote meeting medium are indicated in red. Each green rectangle represents a part of my dissertation project, which aims to address the friction indicated near the rectangle. WIP means work in progress.

Abstract

Meetings are important for collaboration, decision-making, and conflict resolution within groups. While remote meetings offer advantages such as reduced travel time and increased flexibility, they introduce frictions in communication due to the limitations of the medium. This doctoral research aims to examine these frictions and develop new mechanisms to empower the key constituent elements of meetings—attendees and the shared environment—to enhance the effectiveness and efficiency of remote meetings. By exploring methods to improve non-verbal communication, task space management, and the formation of a common context, my work contributes to the design of remote meeting systems that alleviate the effects of existing frictions. The research involves the development and evaluation of prototypes, leveraging technologies such as gesture recognition and generative AI to address the identified challenges.

CCS Concepts

• **Human-centered computing** → **Interactive systems and tools**; *Empirical studies in interaction design*; *Collaborative and social computing systems and tools.*

Keywords

Remote meetings, gestures, screen shares, facial expressions, communication

ACM Reference Format:
Gun Woo (Warren) Park. 2025. Designing Mechanisms to Empower Attendees of Remote Meetings to Promote More Effective and Helpful Meetings. In *Extended Abstracts of the CHI Conference on Human Factors in Computing Systems (CHI EA '25), April 26–May 01, 2025, Yokohama, Japan.* ACM, New York, NY, USA, 5 pages. https://doi.org/10.1145/3706599.3721097

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CHI EA '25, Yokohama, Japan

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ACM ISBN 979-8-4007-1395-8/25/04
https://doi.org/10.1145/3706599.3721097

1 Background and Motivation

Meetings, especially in workplaces, are important tools that enable people to generate ideas, make plans, choose solutions to problems, and negotiate to resolve conflicts [11]. Effective communication in these meetings depends on how attendees interact with each other and their shared environment—factors such as physical or virtual space, available tools, and group norms. Communication theories like the Transactional Model of Communication (TMC) [1] emphasize how these elements shape a dynamic, reciprocal exchange of messages, illustrating the importance of such exchanges for successful communication.

Traditionally, meetings were held in person, where attendees could easily see each other's gestures and share a task environment, such as a whiteboard. With the boom of remote meeting technologies and events like the COVID-19 pandemic, there has been a surge in remote meetings in workplaces [7, 19]. While they offer benefits such as reduced travel time, cost savings, and increased flexibility [10], they come with frictions that can hinder effective exchange between participants and the shared environment (see Figure 1) and hence effective communication. For instance, it is harder to see each other's gestures, as they appear very small, crowded, and are not captured when gestures are large or outside the field of view of cameras [14]. Similarly, sharing the task environment, such as screen sharing, is more challenging and could potentially derail the conversation [16]. These limitations result in friction in conveying visual non-verbal cues, receiving audience feedback, managing shared resources, and forming a common understanding among participants. Understanding these frictions and providing techniques to mitigate their effects on remote meetings is the main focus of my thesis.

Often, these frictions can make attendees perceive remote meetings as inefficient and unhelpful [5, 12, 13]. Given the prevalence of remote meetings—Zoom hosted 3.3 trillion minutes of meetings in 2021 [19]—addressing these frictions can improve collaboration in work environments, teaching, and personal lives.

This research posits that reducing remote meeting-specific frictions could allow participants to fully benefit from the advantages that remote meeting systems offer. Specifically, I will address frictions in communicating using visual non-verbal cues and interacting with the shared environment. By pinpointing, prioritizing, and addressing the sources of friction for each constituent element in meetings, I aim to enhance remote communication experiences.

2 Key Related Work

Challenges in remote meetings can be understood through various communication theories. This thesis leverages two complementary frameworks to examine remote meeting participation and interaction. The **Media Richness Theory** posits that computer-mediated meetings may lack "richness" due to limited information channels, slower feedback, and restricted use of personal focus or natural language [3]. In contrast, the **Media Naturalness Theory** emphasizes the evolutionary advantage of face-to-face communication, suggesting that deviations from this mode increase cognitive effort [8]. These theories help identify the shortcomings of remote meetings and inform strategies to mitigate them, thereby enhancing remote collaboration experiences.

Research indicates that remote meeting software often fails to capture the richness of face-to-face communication, particularly in non-verbal cues like gestures and facial expressions. Participants may struggle to interpret subtle head nods or facial movements in small video views, creating uncertainty about whether the gesture signifies agreement or mere acknowledgment [14]. While chat and emoji reactions can supplement verbal exchanges, they rarely replicate the spontaneous, nuanced interactions of co-located settings.

Additionally, coordinating shared resources—such as slides, documents, and virtual whiteboards—during remote sessions presents challenges. Frequent screen-sharing switches or difficulty tracking the current file can disrupt conversation flow and hinder collective decision-making [16]. These issues highlight how the absence of immediate non-verbal feedback and seamless resource management can impede effective collaboration in remote meetings.

Advancements in technologies like gesture recognition and generative AI offer potential solutions to these challenges. While prior studies have explored ways to enhance communication in remote settings, gaps remain in effectively empowering attendees and optimizing the shared environment.

3 Research Objectives and Questions

Main Research Objective: *This research aims to pinpoint, prioritize, and examine potential frictions in remote meetings and to design mechanisms that empower each constituent element—attendees and the environment—to improve both effectiveness and helpfulness in virtual collaboration.*

I organize this work into three pillars:

(1) **Empowering Attendees**
   RQ1: How can hand gestures serve as a dual-purpose channel for both expression and real-time control of Virtual Reality (VR) presentation content?
   RQ2: How can self-views be designed to encourage more intentional and expressive facial visual non-verbal cues, without forcing them to spend undue attention on a self-view?
(2) **Empowering the Task Space**
   RQ3: How can Generative AI assist in defining a meeting's purpose, surfacing implicit needs, and controlling the task space (e.g., screen share, shared files) while preserving meaningful human oversight?
(3) **Empowering the Environment and Context**
   RQ4: How can remote meeting systems help participants establish and maintain a shared context more effectively?

By addressing these pillars, I seek to reduce friction in remote meetings, enhance communicative richness, and foster more productive collaborative experiences.

4 Research Approach and Methods

A **prototype-driven technology probe** approach [6] guides this research, allowing novel concepts to be explored in realistic settings despite minimal existing benchmarks. Because standardized metrics can miss the complexities of remote collaboration, **qualitative methods** frame user studies to uncover deeper insights.

- **Design and Development of Prototypes:** Drawing on the literature, I identified key frictions and implemented minimal solutions (e.g., gesture recognition, generative AI) that *empower* attendees and the shared environment. As *technology probes* [16, 17], these prototypes provoke reflection on potential impacts, helping users envision how such tools might reshape remote meetings.
- **User Studies:** I conducted qualitative evaluations to assess each prototype's effectiveness in mitigating communication frictions, gathered feedback, and inspired new ideas. Because remote meeting practices vary widely, I opted for in-depth insights over standardized measures, revealing more nuanced opportunities and constraints.
- **Implications and Refinements:** Findings inform user-centered design implications and guidelines that extend beyond individual prototypes (e.g., dual-purpose gestures, AI-driven support). Rather than serving as mere products, these prototypes illuminate how technology can better align with real-world communication needs, enabling more engaged and productive remote collaboration.

5 Results and Contributions to Date

5.1 Literature Research

I conducted a comprehensive review of the literature in communication theory, sociology, psychology, and human-computer interaction. This synthesis has allowed me to examine the key frictions in remote meetings and has informed the design of mechanisms to address them.

5.2 Empowering Attendees to Better Utilize Hand (including arm) Gestures: JollyGesture (RQ1) [Completed]

Figure 2 shows **JollyGesture** [17]. It is a system that utilizes *dual-purpose gestures*—gestures serving both communicative and system-controlling functions. Because remote meetings reduce the richness of communication compared to in-person settings, attendees have fewer opportunities to use hand gestures effectively. Building on this observation, I investigated how users could employ such gestures to improve remote communication. Dual-purpose gestures provide flexibility in their function, making them more meaningful in conveying information. However, performing these gestures requires presenters to be more intentional, which can be challenging. As a solution, JollyGesture guides speakers in real time, eliminating the need to memorize complex motions and helping to enhance the overall communication channel. Through a qualitative user study, I found that JollyGesture can potentially enable presenters to deliver more engaging presentations, highlighting the potential for computer systems to better support remote collaboration.

5.3 Empowering Attendees to Better Utilize Facial Expressions: FaceValue (RQ2) [Ongoing]

FaceValue aims to mitigate the reduced legibility of facial expressions in remote meetings, a communicative friction that arises when attendees cannot easily discern one another's non-verbal cues. To mitigate this issue, I encourage more meaningful self-monitoring of each participant by enhancing self-views. It aims to elicit visual non-verbal cues that are aligned with communication intent from each participant, thereby enhancing the legibility of facial expressions. While self-views are helpful for monitoring one's appearance, research shows that many users fixate on non-communicatively relevant features—such as staying in frame or maintaining a presentable face/background [2, 9]—rather than intentionally crafting expressions to communicate effectively. To address this, FaceValue augments attendees' self-views with AI's interpretation of the attendees' visual non-verbal cues in the form of real-time overlays. Specifically, it leverages Facial Expression Recognition (FER) and embodies design principles distilled from an in-depth review of communication theories. For instance, because FER algorithms are imperfect and facial expressions vary across individuals, *literal* representations of attendees' expressions can mislead rather than inform [18, 20]. As a result, FaceValue provides visual cues that remain open to interpretation, nudging attendees to become more mindful of the non-verbal signals they project without misrepresenting how their expressions appear to others.

5.4 Empowering the Task Space: CoExplorer (RQ3) [Completed]

Figure 3 shows **CoExplorer** [15, 16]. It is a generative AI-powered system designed to optimize window layouts during remote meetings. Meetings often experience phase changes, where the topic of discussion or task requirements (e.g., materials to view together) shift significantly, potentially derailing the conversation [4]. In remote settings, these shifts involve changes in screen sharing or the files being shared, leading to frictions as attendees struggle to choose the right files or programs at the appropriate time [16]. CoExplorer addresses this friction by responding to meeting goals and the immediate activity context, automatically sharing relevant files or programs when appropriate. This potentially facilitates seamless transitions between meeting phases. User studies found that many participants valued CoExplorer's ability to align attendees with the meeting purpose and to automatically select relevant applications or files based on the current phase. However, participants also emphasized the importance of verifying the system's choices and appreciated prompts for confirmation at suitable intervals.

5.5 Supporting the Formation of Common Context: CoEnvironment (RQ4) [Planned]

CoEnvironment assists attendees in establishing a consistent shared context across meetings by monitoring and presenting auto-generated recaps. Using generative AI, it provides participants with summaries of prior discussions in a quickly digestible format, thereby enhancing mutual understanding. The system addresses privacy concerns while exploring the benefits of sharing contextual information across multiple meetings.

These contributions advance remote meeting systems by exploring how autonomous technologies can enhance productivity and improve participant experiences.

Figure 2: Left: Attendees see presenters' gestures, sometimes purely communicative (e.g., '1') or simultaneously controlling the system (e.g., placing a label). Right: JollyGesture's preview mechanism for presenters: (A) the presenter views previews and guidance paths, (B) following a guidance path, and (C) placing the element.

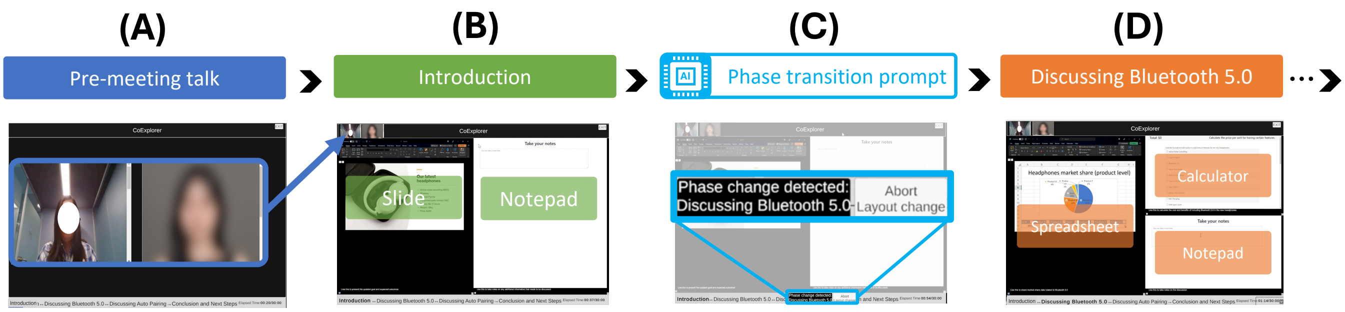

Figure 3: Upon recognition of a phase transition (A to B to D), CoExplorer notifies users and provides them with an option to abort the modification (C). If not aborted, it updates the display to reflect the new phase, as shown in B and D.

6 Expected Next Steps, Open Questions, and Challenges

6.1 Next Steps

I will conduct user testing to validate the effectiveness of **FaceValue**, assessing how the design concepts influence attendees' self-awareness, communicative behaviors, and their ability to address frictions in visual non-verbal communication during remote meetings. This will involve participants from diverse backgrounds and various meeting scenarios in a deployment study to evaluate the system's real-world impact.

Simultaneously, I will initiate the **CoEnvironment** project, which aims to resolve frictions in establishing a common context among remote meeting attendees.

6.2 Open Questions and Challenges

Several challenges remain for both FaceValue and CoEnvironment. A key issue is identifying the optimal contexts to observe the predicted effects, given the significant variation in communication settings—such as one-on-one meetings, team collaborations, or large presentations. Consequently, FaceValue may offer substantial benefits in some scenarios while having limited impact in others.

For FaceValue, it is essential to understand how increased self-awareness of facial expressions affects different users. While some may enhance their non-verbal communication, others might experience increased self-consciousness or anxiety. Balancing the enhancement of self-awareness with the need to avoid negative psychological effects is a key concern.

Regarding CoEnvironment, determining the appropriate amount and type of contextual information to share without overwhelming participants is challenging. Additionally, addressing privacy concerns—ensuring that shared information is handled ethically and remains comfortable for all attendees—is essential.

Another significant question is how these mechanisms interact with diverse communication styles and cultural norms. Since non-verbal cues and self-awareness are deeply influenced by cultural factors, it is important to ensure that FaceValue and CoEnvironment are effective across various user groups.

7 Dissertation Status and Long-Term Goals

The dissertation is approximately 60% complete. I have explored frictions in expressing information through hand gestures and visual non-verbal cues with **JollyGesture** [17], and in managing file/program sharing at significant meeting moments with **CoExplorer** [15, 16], with results evaluated and published. Ongoing work aims to address frictions in visual non-verbal feedback communication with **FaceValue** and in establishing a shared context with **CoEnvironment**, ensuring that all identified frictions are covered.

Looking ahead, my long-term goal is to continue this research in an academic or industry setting specializing in remote communication. Throughout my PhD, I have experienced both the significant benefits and challenges of remote communication while collaborating with supervisors and staying connected with family across continents. This experience drives my commitment to enhancing remote meeting platforms, enabling users to fully benefit from remote communication while minimizing the frictions I have identified.

Acknowledgments

I acknowledge the use of ChatGPT by OpenAI for proofreading this text. This research was generously supported by Meta Reality Labs, the Natural Sciences and Engineering Research Council of Canada (RGPIN-2017-04883, RGPIN-2018-05072), the Faculty of Information at the University of Toronto, and the Department of Computer Science[1] at the University of Toronto. Additionally, this work includes research conducted as part of an internship at Microsoft Research Cambridge ([15, 16]), which also generously supported this work. I sincerely appreciate the members of the Dynamic Graphics Project for their valuable advice and assistance as well as the participants of the user studies for their contributions.

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