



The Potential of Holographic Avatars in the Hybrid Workplace: An Industrial/Organizational Psychology Perspective

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Abstract. Hybrid work, defined as a work arrangement that allows employees to perform work at different locations, will become the most prevalent work model in the next decade. While hybrid work has many benefits, such as the flexibility for employees to work in ways that are most effective for them, it also has drawbacks. Hybrid work is often characterized by ambiguity in work-related information and ineffective communication and may lead to employees feeling disconnected from the rest of the team. Current computer-mediated communication interfaces used in hybrid and fully remote work situations still pose challenges to employees and organizations, such as screen fatigue and lack of non-verbal communication. In this position paper I describe a hypothetical holographic avatar-based two-way communication system that could be used in a variety of hybrid/remote work settings. I discuss how the proposed system could help overcome some of the limitations of current video conferencing tools, fulfill workers' psychological needs and increase workers' motivation.

Keywords: Holographic avatars · Hybrid work · Communication interfaces

1 Introduction

Recent research shows that the main barrier to hybrid/remote working is the need for direct interaction (Wong et al., 2022). With the time spent working remotely expected to increase in the next decade, many employees will need more immersive forms of digital interaction. Holographic interaction systems could provide a solution to this problem by providing a more authentic and immersive form of digital communication.

“Holographic communication refers to real-time capturing, encoding, transporting and rendering of 3D representations, anchored in space, of remote persons shown as stereoscopic images or as 3D avatars in extended reality (XR) headsets that deliver a visual effect similar to a hologram” (Essaili et al., 2022, p. 2). Compared to current video conferencing tools in which workers communicate with each other through small video windows displayed on a flat screen, holographic avatars can convey the nuances

of fully three-dimensional non-verbal communication and provide a sense of presence that leads to more authentic and believable human interactions.

Once confined to the field of science fiction, holographic avatars have now become possible thanks to increased bandwidth and ubiquitous availability of Augmented Reality (AR) devices and due to recent advances in the fields of 3D modeling and animation, AR, and Mixed Reality (MR), game and holographic technologies, Artificial Intelligence (AI), multimodal signal processing and affective computing.

In this position paper I describe a hypothetical mixed reality two-way holographic avatar-based communication system that could be implemented with existing technologies and discuss how the proposed system could overcome the limitations of current communication interfaces in hybrid work settings, increase work performance and improve workers' wellbeing. In Sect. 2, I examine the benefits and disadvantages of hybrid work and current video conferencing platforms. In Sect. 3, I discuss avatar-based communication interfaces and avatar perception. In Sect. 4, I provide a high-level description of the proposed communication system; In Sect. 5 I discuss its benefits, limitations, and possible barriers to adoption.

2 Hybrid Work: Benefits and Disadvantages

Hybrid work is defined as a work arrangement that allows employees to perform work at different locations. According to a McKinsey survey of 100 executives across different industries and countries the hybrid work model will become more common in the future. Most of the surveyed executives expect that most employees will be on-site between 21 and 80 percent of the time, or one to four days per week (McKinsey, 2021).

According to a poll by Gallup of 8,090 hybrid workers (Gallop Workplace, 2022) some of the major advantages of hybrid work include an increase in perceived work-life balance, increased efficiency, the flexibility to choose where and when someone works, less burnout, and greater productivity. Some disadvantages reported in the poll were reduced access to resources and equipment, less connection to organization culture, decreased team interaction, impaired working relationships, and reduced cross-functional communication and collaboration, which was noted as the greatest challenge to hybrid work.

Wong et al. (2022) have substantiated that hybrid work exhibits inherent shortcomings in terms of ambiguity and inefficient communication. In the context of hybrid work environments, the transmission of work-related information predominantly relies on summaries, reports, and video presentations, as opposed to direct experiential learning, informal interactions with colleagues, and observation. Consequently, employees may find themselves devoid of essential contextual information and clarity, which can significantly impact their decision-making and problem-solving abilities. The inefficiency of communication in hybrid work is a well-documented concern (Chang, 2023). According to the well-established Mehrabian's rule, 55% of communication is conveyed through visual cues, such as body language and facial expressions, while 38% relies on vocal cues, including accent, pitch, tone, laughter, and yelling, leaving only 7% attributed to verbal cues like words and connotations (Mehrabian & Ferris, 1967). Although diverse

communication media like emails, chats, phone calls, and videoconferencing facilitate communication in hybrid work settings, they often lack the crucial nonverbal cues necessary for effective communication.

The Gallop report (Gallop Workplace, 2022) also showed that hybrid workers spent most of their time in the office in meetings with coworkers and supervisors and on collaborative work with colleagues, whereas when working from home, workers were primarily focused on independent work tasks and reported far less time spent in meetings/collaborative activities with coworkers, customers, and supervisors. One factor contributing to this divide in activities in the office versus time spent at home is the absence of a socioemotional connection while video conferencing. Many workers would rather have meetings in person, as video conferencing does not provide the same level of personal connection and understanding that in-person meetings do.

Current video conferencing platforms such as Zoom, Microsoft Teams and Cisco Webex, which allow users to connect in real time through audio and video pose challenges to employees and organizations. First, video conference meetings can feel impersonal and even with video enabled, employees are simply communicating with screens, and this may prevent employees from developing authentic connections with their coworkers. Second, staring at a flat screen for hours is physically and psychologically draining. Third, one of the most important elements of in-person meetings is how we read others. Video conferencing can inhibit our minds' ability to process movements and body language. We do not gesture, move, or convey emotions as effectively on screen, nor do we read them as well, either. The lack of body language influences effective delivery of the intended message and interferes with close and trusting relationships and social presence among workers in hybrid work settings (Park, 2020).

If there were a way to increase the effectiveness of video conferencing calls by eliciting a greater socioemotional connection between coworkers, resulting in more authentic and efficient meetings whilst at home, the positive aspects of working in the office (such as increased connection and collaboration) could be harnessed from one's home resulting in greater hybrid work potential.

3 Avatar-Based Communication Interfaces

Avatars are a common feature in numerous computer-mediated communication and interaction interfaces, and their prevalence is on the rise (Wu et al., 2021). Various definitions of the term "avatar" are being used, encompassing a spectrum that extends from 2D static icons to highly detailed human replicas. For the purposes of this paper, the term "avatar" is employed to refer specifically to lifelike 3D animated digital human characters.

"Among the first judgments made of an avatar in a digital [or mixed reality environment] is determining its ...humanity" (Nowak & Fox, 2018, p. 35). Research studies have shown that people are likely to establish stronger connections with avatars that show human features (Sheehan & Sosna, 1991). More specifically, HCI scholars argue that 'agency', 'anthropomorphism', and 'realism' are the three most important characteristics affecting people's perceptions of avatars (Nowak & Fox, 2018). Agency refers to the degree to which an entity is perceived to be human, anthropomorphism refers to

an entity having human form and/or behavior and realism refers to having accurate form and/or behavior.

While the terms ‘avatar’ and ‘agent’ are often used interchangeably, they typically refer to distinct entities. In general, an avatar is a virtual human character whose actions are guided by a human operator, whereas an agent is a virtual human whose actions are determined by a computer algorithm. Research comparing agents to avatars has demonstrated that representations controlled by humans or perceived as being controlled by humans tend to be more persuasive than those controlled or perceived to be controlled by autonomous agents (Nowak & Fox, 2018). Based on these empirical findings, I posit that a future effective interaction system centered around avatars should incorporate holographic avatars that are partially under the control of their human counterparts, such as remote employees, possibly facilitated through handheld devices (refer to Fig. 1).

Prior research also shows that a higher level of form and behavioral anthropomorphism may lead to increased user engagement, social presence, and interaction effectiveness (Bailenson et al., 2006; Kang & Watt, 2013). Anthropomorphism is also related to social influence; digital representations that show a high degree of anthropomorphism are likely to be more persuasive (Guadagno et al., 2007). Drawing on these research findings, I envision a system of animated avatars that not only have human appearance, but also speak, move, gesture and express emotions in the same ways as humans.

Avatar realism can be defined on different levels. For instance, in regard to appearance, Steed and Schoereder (2015) define avatar realism as faithfulness of its representation, while they define behavioral realism as natural, accurate physical behavior. Some research studies suggest that the photorealism of an avatar may enhance the feeling of co-presence in AR systems, e.g., the belief that the remote person is actually there (Orts-Escolano et al., 2016). Pakanen et al. (2022) argue that in professional settings, such as educational or work environments, the avatar should look like its human counterpart and be clearly recognizable, as people need to be sure that the person is the one that they expect to be in order to trust them.

Hence, a system of holographic photorealistic avatars that look and behave exactly like their human counterparts might be the best solution. However, there are also advantages in using avatars whose appearance is different from their human correspondents. For instance, it is widely understood that individuals with disabilities often experience workplace bias and discrimination. Yet, when they can choose an identity and embodiment in VR/AR environments, the results can be extremely positive (Davis & Chansiri, 2019).

4 Holographic Avatars in the Hybrid Workplace: A Vision for the Future

Recent advances in 3D modeling and animation, AR/MR, game and holographic technologies, AI, multimodal signal processing, and affective computing together with increased bandwidth and ubiquitous availability of AR devices are paving the way for the next generation communication/interaction interfaces in the workplace.

Figure 1 illustrates a two-way holographic avatar-based interaction system that could be used in a variety of work contexts to overcome the limitations of current video conferencing systems. The employee working remotely controls the holographic avatar (on the

job site) via speech input through a handheld device. The avatar model, which could be a high-fidelity replica of its human counterpart (e.g., a digital twin), can be created using a variety of methods including manual sculpting in a 3D modeling software, photogrammetry techniques, or 3D scanning. The avatar rig, including the skeleton and animation controls can be manually created in an animation software or generated automatically using auto rig tools. The avatar animation is generated by performing speech analysis: (1) phonemes are identified from the speech and mapped to the corresponding visemes (mouth shapes) to generate the avatar lip synch animation;

(2) data-driven approaches, such as machine learning and deep learning are used to generate conversational gestures and facial articulations on-the-fly from speech input (Asakawa et al., 2022); and (3) affective/expressive gestures are identified based on speech prosody analysis and rule-based methods (Adamo et al., 2021) and retrieved from a database of previously captured gestures of the employee—the employees are videotaped at different times, their affective/expressive gestures are extracted from the videos and transformed into animation data which is stored in a gesture database. The result is a human-controlled full-body animated holographic avatar that is viewed by the onsite employees as a holographic projection (Arcao et al., 2019) or through an AR headset, such as Microsoft HoloLens. The avatar speaks, moves and gestures exactly like their human counterpart.

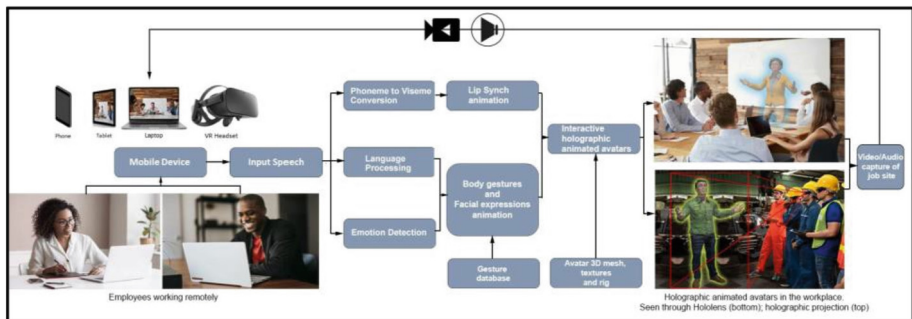


Fig. 1. Diagram illustrating a hypothetical mixed reality two-way holographic avatar-based communication/interaction system in hybrid work settings.

A 360-degree camera capturing what is happening on the jobsite/office sends back a continuous video/audio stream to the remote employee. The remote workers can display the video/audio signal on a laptop, tablet or phone or they can view the other employees who are on the job site or in the office through a VR headset, which allows for a more immersive experience. This two-way communication can be implemented using a game engine, such as Unity.

5 Discussion

The proposed mixed reality holographic avatar-based communication system could be applied to many work contexts. When training employees from remote locations, a holographic avatar may provide a more intimate context for employees to learn, eliciting

the feeling that someone was actually there to teach in physical form, thus providing a socioemotional connection that may result in increased learning. When recruiting or interviewing many candidates at once or one on one, a holographic digital twin of the interviewer may create a more personable experience for applicants resulting in less dropout rates. When having employment or termination conversations, an avatar may contribute to feelings of ease and stave off perceived indifference from a company to an employee. Employees often have feelings of insignificance when being let go through a screen, whereas the avatar may help to create a more personable and candid situation in which the employee doesn't harbor feelings of resentment due to perceived indifference on the part of the company.

The proposed mixed reality holographic avatar interaction system will help overcome the problems of ineffective communication and ambiguity discussed in Sect. 2. By communicating using visual (face and body), vocal, and verbal cues, the holographic avatars will allow for more efficient communication. Further, by conveying the feeling that the remote workers "are really there" on the job site, the holographic avatars will afford more direct experiences and interactions and hence, less ambiguity in work-related information.

In accordance with self-determination theory, workers exhibit autonomous motivation when their three fundamental psychological needs are met: autonomy, relatedness, and competence (Deci & Ryan, 2000; Gagné & Deci, 2005). Autonomy is defined as "the experience of acting with a sense of choice, volition, and self-determination" (Stone et al., 2009). When workers have the freedom to decide when, where, and how they work, their psychological need for autonomy is fulfilled within the workplace. The second psychological need, relatedness, is described as "the experience of having fulfilling and supportive social relationships" (Stone et al., 2009). When workers perceive a lack of meaningful connection with their colleagues and a lack of support for their work, their satisfaction of the psychological need for relatedness diminishes, potentially leading to a decline in motivation. Competence refers to "the belief that one possesses the ability to influence important outcomes" (Stone et al., 2009). In a hybrid work environment often characterized by ambiguity, if workers lack clarity due to the absence of direct and authentic interactions with their co-workers, they may develop doubts about their competence to successfully carry out their work. This uncertainty can erode their autonomous motivation towards their tasks (Deci & Ryan, 2000; Gagné & Deci, 2005).

The avatar-based two-way interaction system will enhance workers' (1) *competence*—the remote employee, such as for instance a factory supervisor, can "teleport" to the job site, monitor the situation and provide expert advice where it is needed by communicating in a more direct and effective way with the onsite workers through a full body three-dimensional avatar that speaks gestures and conveys emotions. (2) *Autonomy*—by controlling their holographic avatar via speech through a standard mobile device, the employees can perform their work effectively and establish a sense of presence from any location. (3) *Relatedness*—through holographic avatar teleportation, which allows for verbal/vocal/visual communication and an enhanced feeling of immersion, presence and immediacy, the remote workers can establish stronger and more authentic social connections with the onsite employees.

Holographic avatar-based communication has also the potential to improve diversity, equity, and inclusion in the workplace. Recent research suggests the importance of choice in avatar representation for creating inclusive work environments for people with disabilities and underrepresented groups in general (Davis & Chansiri, 2019). On the other hand, some researchers caution that avatar-based virtual work environments do not constitute unconditional and neutral spaces and workplace avatars whose appearance can be customized by the employee “*may produce a new locus for bias to flourish*” (Martin, 2012, p. 605). Another possible drawback of avatar technology is the feeling of uncanniness that could be experienced when the avatars try to replicate the appearance and behaviors of their human counterparts (Mori & Mcdorman, 2012).

5.1 Limitations and Future Work

One limitation of the proposed system is that the benefits of the holographic avatars are only available on the jobsite, as the remote worker still sees and interact with the other employees through a flat screen or a VR headset (which allows a more immersive experience than a flat screen). Based on the presented motivation and introduction, it would also be important for the remote worker to experience the advantages of holographic presence. This could be accomplished in a future development of the system by creating a shared holographic workspace in which all employees, represented by their digital twins, can share content, and communicate with each other through speech, facial expressions, and body language.

Another limitation is that the avatars described in the proposed system are not completely human-controlled. In Sect. 3, I argue that avatars controlled by humans are more persuasive than those controlled by autonomous agents. However, the avatars in the proposed system are only partially controlled by humans, as some gestures and facial expressions are generated on the fly from speech input. One might argue that the algorithmically generated gestures and facial articulations might not actually match the ones of the real human and thus lead to a discrepancy between audio and behavior, adding to ambiguity, rather than improving clarity and communication. One way to solve this problem would be to motion capture larger sets of gestures and facial articulations of each employee, store them in a database and retrieve all gestures from the database rather than generate them on the fly. This would reduce the possibility of the avatar’s gestures not matching the expressive style of the real human and would decrease the risk of uncanniness and ambiguity.

Additional potential barriers to the implementation of holographic avatars in hybrid work settings include high initial cost of infrastructure, bandwidth limitations, reluctance to adapt to new trends and lack of technical know-how. I anticipate that these barriers will be overcome by future technology advances and by a more technically prepared future workforce.

Despite these potential obstacles, the holographic avatar system presented in this paper represents a step forward toward future highly technological work environments in which the differences between human-computer interactions and human-to-human interactions are becoming less and less pronounced. Further, in the future of work in an increasingly digital world, holographic avatars may contribute to the creation of more

inclusive workplaces by providing increased access and creative opportunities for people who are often marginalized as ‘misfits’.

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