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Ethical Implications of Virtual and Augmented Reality in Workspaces: Challenges and Opportunities to Promote Inclusion and Safety

Joshua Chong[1,2], Xinyi Tu[2,3,4], and Matteo Zallio[2,5]

[1]Hunter College High School, New York City, NY 10128, USA
[2]Metavethics Institute, Cambridge, United Kingdom
[3]Aalto University, School of Engineering, DigiTwin Lab, Espoo, Finland
[4]University of Cambridge, Institute for Manufacturing, Cyber-Human Lab, Cambridge, United Kingdom
[5]University of Cambridge, Department of Architecture, Cambridge, United Kingdom

ABSTRACT

Contemporary workspaces are constantly evolving, and we have seen the emergence of remote and hybrid workspaces using virtual and augmented reality. With these advancements come many ethical considerations that need to be identified and addressed before these environments become more widespread. This includes issues concerning inclusion, access, and safety of Virtual Reality (VR) and Augmented Reality (AR) technologies in both virtual and in-person workplaces. Two research questions arise: (1) What are the ethical considerations and potential challenges associated with the use of VR and AR technologies in hybrid and virtual working environments? (2) How do these technologies impact inclusion, access, and the safety of shared content in hybrid and virtual workplaces? To answer these questions, our study systematically analyzes recent research on the ethical implications of VR and AR technologies in hybrid and virtual working environments. A total of 13 studies were identified based on specific inclusion criteria, such as the publication date and the presence of certain keywords in the title or text. While the research found some articles on the ethics of VR, AR, and the metaverse that briefly discuss work-specific dilemmas, we found scarcity of studies that focused specifically on ethics in VR, AR, and metaverse in the context of working environments. With this study we aim to provide a comprehensive understanding of some of the challenges and opportunities that VR and AR technologies can offer to users of workspaces and offer recommendations for organizations to address these ethical dilemmas in the name of inclusion and safety.

Keywords: Metaverse ethics, Workplace metaverse, Virtual reality, Augmented reality, Systematic literature review

INTRODUCTION

The rapid integration of virtual reality (VR) and augmented reality (AR) technologies in hybrid working environments presents a multitude of ethical dilemmas that demand thorough examination. This work aims to delve into the challenges related to ethics, inclusion, access, and the safety of

content shared through VR and AR in both virtual and in-person workspaces. As hybrid working models, where individuals alternate between office and remote work, become increasingly prevalent, new opportunities and inequalities emerge. This dynamic is particularly evident when considering scenarios such as remote meeting attendance via VR or AR while others are physically present in the office, raising significant questions about the fairness and equity of the experience and resource access.

Existing literature highlights various ethical concerns in the deployment of VR and AR technologies. For instance, Roesner and Kohno (2014) discuss the privacy and security issues inherent in AR systems, while Madary and Metzinger (2016) explore the moral implications of VR immersion. The unique context of hybrid work further complicates these issues, necessitating a focused exploration of the specific ethical considerations in such settings.

This paper aims to address these complex challenges through a comprehensive analysis of case studies and examples, providing an understanding of how these ethical dilemmas are currently managed, what measures are in place, and their effectiveness. By systematically reviewing academic literature, we seek to inform best practices and offer recommendations for organizations navigating the ethical landscape of VR and AR technologies in hybrid working environments. The paper focuses on the following two research questions: RQ1: What are the ethical considerations and potential challenges associated with the use of VR and AR technologies in hybrid and virtual working environments? RQ2: How do these technologies impact inclusion, access, and the safety of shared content in hybrid and virtual workplaces?

BACKGROUND

The metaverse is a transformative digital concept that can be segmented into three broad categories: the consumer, enterprise, and industrial metaverses. Each type differs in scope, complexity, and potential benefits for individuals, organizations, and industries. The consumer metaverse primarily targets social interaction, entertainment, and e-commerce, providing users with immersive digital experiences that extend beyond traditional media and commerce. This type of metaverse offers new ways for companies to engage with consumers, allowing them to create interactive and personalized virtual spaces. For instance, Nike's launch of Nikeland on Roblox allows users to explore virtual environments, try products, and engage with the brand in new ways (Evans, 2021). Similarly, luxury brands like Gucci have explored NFT-based virtual goods, which have generated significant revenues and customer engagement (Latimore, 2022). Scientific studies suggest that the consumer metaverse fosters brand loyalty and enhances customer experiences through immersive VR environments, ultimately influencing purchasing behaviors (Johnson et al., 2022). As virtual commerce evolves, the consumer metaverse promises to transform how consumers shop, interact with brands, and engage in social activities (Yasuda, 2024).

The enterprise metaverse focuses on creating virtual environments that enhance internal business processes, such as employee collaboration, training,

and onboarding. By utilizing virtual platforms and digital twins, businesses can create immersive workspaces where employees interact as if they were physically present. For example, Microsoft's Mesh for Microsoft Teams integrates 3D avatars and virtual workspaces to provide a more engaging and interactive platform for remote collaboration (Miller, 2023). Research shows that enterprise metaverse environments improve employee engagement and foster creativity by simulating in-person interactions (Gartner, 2022). The hybrid work model, which combines remote and in-office work, has further driven the adoption of enterprise metaverse technologies (Thompson et al., 2023). These immersive virtual environments facilitate real-time communication and collaboration, making them particularly effective for globally distributed teams (Smith et al., 2022). The enterprise metaverse also extends to talent acquisition and onboarding, where companies can conduct virtual interviews and training simulations. Accenture, for instance, has used the enterprise metaverse to onboard thousands of employees in a virtual campus, enabling employees to interact with their new colleagues in a digital replica of their office environment (Wheeler, 2022). The integration of digital twins—virtual models of physical office spaces and workflows—has become a key element in this space, allowing remote employees to access the same tools and resources as their in-office counterparts (Chen et al., 2022).

The industrial metaverse is the most complex and far-reaching, aiming to revolutionize manufacturing, supply chains, and logistics (Tu, 2024). It leverages technologies such as digital twins, Internet of Things (IoT), artificial intelligence (AI), and 5G to create interconnected ecosystems where virtual and physical systems operate in synchronization (Patel et al., 2023; Tu et al., 2024). In this metaverse, digital twins provide real-time monitoring and predictive analytics, optimizing industrial processes and decision-making (Tu et al., 2023). For example, BMW has implemented digital twins in its production systems, simulating global manufacturing processes to improve efficiency and reduce costs (Green et al., 2022). Studies indicate that integrating AI and digital twins within industrial settings not only improves operational efficiency but also enhances sustainability by enabling businesses to reduce waste and optimize resource use (Andrews & Baker, 2022). The industrial metaverse has the potential to reshape industries by providing firms with tools for cross-border collaboration, real-time decision-making, and predictive maintenance (Lee et al., 2023). It offers significant economic, environmental, and societal benefits, facilitating a more connected and sustainable global industrial ecosystem (Johnson & Zhao, 2022). Despite the opportunities offered by these different technologies, an area of interest for many scientists is the new discipline of Metavethics, the ethics applied to metaverse and digital, virtual environments (Zallio et al., 2022; Zallio et al., 2023a; Zallio et al., 2023b).

Focus on Hybrid Working Environment Within the Enterprise Metaverse

A major trend within the enterprise metaverse is the development of hybrid working environments, which combine physical and virtual workspaces.

The hybrid work model, which became prominent during the COVID-19 pandemic, has continued to evolve, with more organizations adopting virtual platforms to support flexibility and productivity (Zhao & Andrews, 2022). Hybrid working environments enable employees to transition seamlessly between in-office and remote work, using immersive technologies to replicate the physical workspace. The use of virtual meetings, immersive training sessions, and collaborative virtual spaces allows remote employees to work with the same level of engagement as their in-office counterparts (Smith et al., 2022). Additionally, digital twins in hybrid environments provide real-time access to virtual models of office spaces and tools, enabling efficient collaboration regardless of physical location (Tu et al., 2021; Thompson et al., 2023).

The hybrid working environment within the enterprise metaverse also fosters greater inclusivity by enabling a more distributed workforce, which is particularly beneficial for global companies and remote teams. By leveraging immersive technologies, companies can maintain productivity while offering employees the flexibility to work from anywhere (Miller et al., 2022).

METHODOLOGY

This paper employs a systematic literature review (SLR) to identify and analyze existing research on the ethical considerations, challenges, and impacts of VR and AR technologies in hybrid and virtual work environments. The primary goal is to uncover ethical concerns related to inclusion, access, and the safety of shared content in these evolving digital workplaces. We follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021), addressing the two aforementioned research questions regarding ethical considerations, as well as inclusion, access, and safety. The following inclusion criteria were applied: (1) Research focus: Works that specifically address the ethical considerations of VR/AR technologies in workplace settings, including discussions of inclusion, access, and content safety. (2) Publication type: Peer-reviewed articles, conference reports, industry reports, and case studies. (3) Language: Only articles written in English. (4) Timeframe: Studies published between 2020 and the present, reflecting the rapid growth of virtual work environments and the metaverse in recent years. This timeframe is justified by the increasing academic and industry interest in virtual workspaces, particularly due to the global shift toward remote and hybrid work caused by the COVID-19 pandemic. Exclusion criteria were applied to eliminate irrelevant studies, particularly those that focused on general remote work without VR/AR components, construction safety training, or VR/AR tools for physical safety training outside the workplace context.

The review began with a comprehensive search of the selected databases using the defined search strings. Articles were screened based on their titles and abstracts, followed by a full-text review of those that met the inclusion criteria. Where the number of relevant articles was insufficient, the search was expanded to include grey literature, such as industry reports and case studies, to ensure a comprehensive understanding of the topic.

The initial search was conducted on July 13, 2024, and the final revised search was completed on August 16, 2024. Keywords were identified based on the research questions and categorized into three groups: Technologies, Ethics, and Workplace: Technologies include 'Virtual Reality', 'Augmented Reality', 'VR', 'AR', 'Metaverse', 'XR', 'MR', 'extended reality', 'mixed reality', 'virtual worlds', 'immersive technology'; Ethics include 'Ethics', 'Ethical', 'Privacy', 'Security', 'Inclusion', 'Access', 'Safety'; Workplace include 'Virtual work environments', 'Hybrid work environments', 'Remote work', 'Telework', 'Teleworking', 'Immersive work'. These keywords were systematically applied across three primary academic databases: Google Scholar, ACM Digital Library, and IEEE Xplore. In each database, Boolean search strings were constructed to ensure comprehensive coverage of literature related to both the technical and ethical aspects of immersive work technologies.

This search produced 131 results from Google Scholar. After going through each of the initial results, only 1 article was found that related to the research questions (Greene, 2024). The same result was produced when using the same search in the ACM digital library, and 0 results were produced from the IEEE Xplore database. To focus the search on the research questions, additional keywords for virtual reality were included: XR, MR, extended reality, mixed reality, virtual worlds, and immersive technology, as well as more keywords for the workplace: 'telework', 'teleworking', and 'immersive work'. All other keywords were removed except for 'ethics' and 'ethical' in order to filter out the papers on work safety that were found before. This second search still came up short with only 14 results from Google Scholar, of which they included the same results as previously found. Therefore, the search was broadened by removing the keywords related to work, and searching through the results for papers that had sections on work. This led to 480 initial results from Google Scholar, 16 results from ACM Digital Library, and 35 results from IEEE Xplore. Table 1 illustrates the steps and number of works selected in this process.

In Google Scholar, an initial search yielded 480 articles, which were filtered based on relevance, scope, and focus on the ethical dimensions of immersive technologies in workspaces. Many articles unrelated to VR/AR technologies or focused on general remote work were excluded. After this refinement, 10 key articles were selected for further analysis. In ACM Digital Library, from 16 initial results, this search produced 1 relevant articles that directly addressed the ethical concerns of using VR/AR in workplace settings, focusing on topics such as privacy, inclusion, and safety. In IEEE Xplore, out of 35 initial results, the search identified 4 articles relevant to the research questions, which were reviewed to extract findings related to the ethical implications of immersive technologies in workspaces. After 2 duplicate articles were removed from the results, the following articles were selected for the systematic review: 8 papers from Google Scholar, 1 article from the ACM Digital Library, and 4 article from IEEE Xplore. These articles form the foundation of the analysis in this study and provide insights into the ethical challenges, inclusion issues, and safety concerns associated with the use of VR/AR technologies in workspaces.

Table 1. Overview of the systematic literature review process.

	Google Scholar	ACM Digital Library	IEEE Xplore	Total
Identification	n = 480	n = 16	n = 35	n = 531
Non-open-access results excluded	n = 310	n = 6	n = 34	n = 350
Non-English results excluded	n = 296	n = 6	n = 34	n = 336
Content-irrelevant results excluded	n = 10	n = 1	n = 4	n = 15
Duplicates Removed	n = 8	n = 1	n = 4	n = 13

RESULTS AND DISCUSSION

This section presents the findings from the systematic literature review, focusing on the ethical considerations and challenges associated with the use of VR and AR technologies in hybrid and virtual working environments (RQ1), and how these technologies impact inclusion, access, and the safety of shared content in these workspaces (RQ2). Thirteen relevant studies were identified and analyzed, revealing eight key themes.

Privacy and Data Security: Pervasive AR technologies have the capability to continuously collect extensive data from the user's environment, potentially leading to the exploitation of sensitive information (Regenbrecht et al., 2022). The "always on" and "disappearing interface" nature of these technologies can make data collection less noticeable to users, raising concerns about unauthorized surveillance and data misuse. Employers utilizing VR and AR technologies can constantly track employees, blurring the lines between public and private spaces and potentially violating privacy rights (Adomaitis et al., 2022). Data privacy notices associated with these technologies are often lengthy and difficult to understand, leaving users unaware of the specific data being collected and how it is used (Prillard et al., 2024). The lack of transparency regarding real-time data collection by both software and hardware components exacerbates these concerns. The need for transparency about data handling practices is crucial. Companies should openly communicate what information is collected, how it is stored, and the purposes for which it is used (Tiainen, 2024). Ensuring data is securely stored without the risk of breaches is essential to protect employee privacy. Additionally, there are concerns about data misuse, fake experiences, and cybersecurity threats such as identity theft, emphasizing the importance of robust data protection measures (Middleton, 2022).

Employee Monitoring and Surveillance: The use of VR and AR technologies facilitates extensive monitoring of employee activities, leading to ethical questions about surveillance and autonomy. Employees working within the metaverse or utilizing AR systems may be subject to detailed tracking of their movements, behaviors, and interactions (Yasuda, 2024). This level of surveillance can infringe on employee rights and raises significant concerns about the ethical limits of monitoring in workspaces. Over-monitoring can negatively affect workplace relationships and contribute to a climate of mistrust (Adomaitis et al., 2022). The potential for employers to misuse collected data for purposes beyond enhancing productivity, such

as micromanagement or punitive measures, highlights the need for clear policies and ethical guidelines governing employee surveillance (Benjamins et al., 2023).

Inclusion and Accessibility: Studies have found that current XR headsets may only be comfortable for about 50–60% of the population, potentially leading to the exclusion of workers who cannot wear the devices comfortably or for extended periods (Cox et al., 2024). This discomfort can disadvantage employees who are required to use such technologies to fulfill their job responsibilities. People with disabilities face additional barriers, as XR technologies often lack necessary accessibility features (Fox & Thornton, 2022). The immersive nature of these technologies requires a rethinking of traditional accessibility accommodations. Inaccessibility, combined with factors like poverty and discrimination, can deepen the digital divide, leading to unequal opportunities and reinforcing existing social inequalities. Workplace exclusion and discrimination risks are further amplified when physiological differences affect an individual's ability to adopt these devices (Brun et al., 2020). Ensuring that XR technologies are designed with inclusivity in mind is essential to prevent discrimination and promote equal access for all employees.

Physical and Mental Health Risks: The physical health risks associated with VR and AR devices include strain from the weight of headsets, eye fatigue, headaches, and the potential for accidental injuries such as collisions or falls due to reduced situational awareness and limited field of view (Tiainen, 2024; Brun et al., 2020). Prolonged use of these devices can also lead to discomfort and long-term health issues, necessitating proper training and ergonomic considerations. Mental health risks are also significant. The datafication of labor and immersive nature of VR and AR technologies can lead to feelings of isolation, reduced human interaction, and a loss of meaning in work (Brun et al., 2020). The potential for technology addiction and antisocial behavior is a concern, as employees may become overly dependent on virtual environments, affecting their psychological and emotional well-being (Boni, 2023; Middleton, 2022).

Datafication of Labor and Employee Autonomy: The metaverse and VR/AR technologies enable the detailed tracking and analysis of employee work patterns, efficiency, and deliverables (Yasuda, 2024). This datafication of labor can lead to workers being viewed as mere accessories to machines, potentially harming their psychological health and diminishing their sense of autonomy. The use of conversational agents and chatbots in the workplace can decrease direct interactions between human collaborators, leading to impersonal communication and isolation (Adomaitis et al., 2022). Ethical concerns arise regarding who controls these systems and who is responsible for their outputs, emphasizing the need for transparency and accountability. Exploitation and power imbalances may be exacerbated, as these technologies can serve as mechanisms for control and data collection rather than solely enhancing efficiency (Greene, 2023). The framing of AR technologies as tools for worker enhancement may obscure the invasive nature of monitoring practices and their potential negative impacts on employee well-being.

Bias and Discrimination: Bias and discrimination are critical ethical challenges in the implementation of VR and AR technologies. There is a risk that these technologies could reproduce existing social biases and power dynamics, further exacerbating inequalities (Marques et al., 2023). Gender bias, data protection issues, and labor market disparities may arise if ethical considerations are not adequately addressed (Adomaitis et al., 2022). Ensuring that XR technologies do not perpetuate undesired or unlawful discrimination is essential. This includes addressing biases in AI algorithms used within these systems and promoting diversity and inclusion in their design and deployment (Fox & Thornton, 2022).

Need for Ethical Standards and Transparency: The literature emphasizes the importance of establishing transparent principles and ethical standards for the use of VR and AR technologies in the workplace. There is a need for international standards to guide the ethical development and implementation of these technologies, ensuring they are beneficial and respect the rights of all stakeholders (Middleton, 2022). Companies should actively participate in efforts to standardize the metaverse and related technologies, creating ethical guidelines that address issues such as data privacy, employee rights, and consumer protections (Tiainen, 2024; Marques et al., 2023). Transparency regarding data collection, usage, and storage is crucial to build trust and safeguard against unethical practices.

Safety of Shared Content: The safety and security of shared content in hybrid and virtual workplaces are significant concerns. Collaborators may need access to sensitive information, necessitating robust security measures to protect data from unauthorized access or breaches (Marques et al., 2023). Security concerns relate to input protection, data protection, output protection, user interaction protection, and device protection. There is also a need to separate private from public spaces within virtual environments to maintain confidentiality and respect personal boundaries. Ensuring that sensitive information is adequately protected helps prevent discrimination, maintains fairness, and upholds ethical standards in collaborative work settings.

CONCLUSION

Findings reveal that while VR and AR technologies offer transformative potential for hybrid and virtual work environments, they introduce significant ethical considerations that must be thoughtfully addressed. These include privacy risks from continuous data collection and potential unauthorized surveillance; threats to employee autonomy due to extensive monitoring; exclusion and discrimination resulting from lack of accessibility for all users, particularly those with disabilities; physical and mental health risks associated with prolonged use; and the perpetuation of social biases through biased algorithms and designs. To address these issues, organizations must proactively develop clear ethical guidelines, ensure transparency in data practices, and prioritize inclusive and accessible design. By adopting these best practices, companies can harness the benefits of VR and AR technologies

while safeguarding employee rights and well-being, thus creating safer and more equitable modern work environments.

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