

Yang, Liang

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Metaverse Identity: Core Principles and Critical Challenges

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Metaverse Identity: Core Principles and Critical Challenges

Abstract

This paper explores the core principles that should guide the construction and governance of identity in the metaverse and identifies the critical challenges that need to be addressed. Drawing on multidisciplinary theories and perspectives, we propose two core principles for metaverse identity: Equivalence and Alignment, and Fusion and Expansiveness. The first principle contends that metaverse identities should be consistent with real-world identities in terms of norms and standards, which is crucial for establishing guidelines and safeguarding rights. The second principle emphasizes the necessity for seamless integration and boundless expansion of metaverse identities, transcending real-world limitations to accommodate diverse needs and foster inclusive participation. We argue that these two principles are vital for ensuring the accountability, inclusiveness, and consistency of identity in the metaverse. We also identify five critical challenges: Identity Interoperability, Legal Implications, Privacy and Identity Management, Deepfakes and Synthetic Identities, and Identity Fragmentation and Psychological Well-being. We discuss potential strategies to navigate these challenges. The paper concludes by underscoring the importance of a proactive and collaborative approach to shaping the future of metaverse identity. As the metaverse continues to evolve, it is imperative that we cultivate a thorough understanding of the principles and challenges surrounding identity in this uncharted territory and work collectively to build a metaverse that fosters responsible identity construction and expression.

Keywords: Metaverse, Identity, Governance, Principles, Interoperability, Privacy, Deepfakes, Synthetic Identity, Identity Fragmentation

1. Introduction

The metaverse is envisioned as the future of the Internet, aspiring to offer a spatial and social Internet experience that seamlessly blend the physical and digital realms using both existing and emerging technologies (Venugopal et al., 2023; Hollensen et al., 2022; Koohang et al., 2023). Over the past few decades, and particularly in the last three years, scholarly research on the metaverse has extensively covered various dimensions, including technological advancements (Park and Kim, 2022b; Xu et al., 2022; Huynh-The et al., 2022; Fu et al., 2023), ecosystem dynamics (Lee et al., 2021), social impacts (Hennig-Thurau et al., 2022; Šimová et al., 2023; Park and Kim, 2022b), economic potential (Bhattacharya et al., 2023), and user behavior and experiences (Riva and Wiederhold, 2022; Park and Kim, 2022a; Buhalis et al., 2022).

However, the development and adoption of the metaverse also presents new challenges. In January, the International Criminal Police Organization (INTERPOL) released a research report titled "Metaverse - A Law Enforcement Perspective." This report underscores that, despite its nascent stages, the metaverse already poses urgent technological, social, and ethical challenges that demands immediate attention. Notably, the metaverse has facilitated the emergence "meta-crimes," new types of criminal activities that are increasingly concerning as immersive worlds become more integral to our daily lives. Moreover, the report highlights significant governance and policy is-

ssues, with the construction of identity within the metaverse being a the primary one. It notes that the anonymity of identities within the metaverse has been exploited for illegal activities such as trafficking stolen goods or promoting unlawful behavior. Additionally, the legal status of avatars remains undefined, prompting the international community to actively explore their legal responsibilities and definitions (INTERPOL, 2024).

In March, the World Economic Forum (WEF) released a report entitled "Metaverse Identity: Defining the Self in a Blended Reality." This report elucidates that the metaverse acts as a conduit merging the digital and physical worlds, thereby revolutionizing interactions with information, individuals, and environments. Within this transformative context, identity stands out as a critical element, essential for promoting inclusivity, fairness, accessibility, security, and privacy within the metaverse. The report warns that neglecting the evolution of identity in the metaverse could result in the perpetuation of existing internet flaws. Poorly designed metaverse identities could adversely affect social mobility in the physical world—amidst our increasing reliance on digital platforms—and hinder the secure and private identification, authentication, and verification of individuals or digital entities. Furthermore, these identities may unintentionally endow technology with human-like attributes, cultivating excessive trust and potentially leading to various psychological and emotional harms (WEF, 2024).

The two research reports underscore that the rapid advancement of metaverse technology has elevated identity to a foundational discussion topic within the domain. Identity, by its nature, is a broad socio-technical concept; similarly, Metaverse Identity is a complex, multidimensional, and multilayered concept (WEF, 2024). Existing research often treats identity merely as a foundational concept within the metaverse, supporting discussions across diverse topics in various disciplines and perspectives. WEF notes a significant gap in a comprehensive understanding framework for Metaverse Identity that encompasses diverse stakeholder perspectives (WEF, 2024).

This paper aims to systematically review academic research concerning Metaverse Identity, to explore its intrinsic characteristics and impacts, and to propose core principles that aid stakeholders in intuitively understanding both Metaverse Identity and its broader impacts. Additionally, this study seeks to identify the current critical challenges, aiming to provide theoretical references and insights for technological innovations, ethical standards, and policy developments related to Metaverse Identity. Employing a comprehensive, primarily qualitative methodology, this study will integrate literature reviews, textual analysis, comparative studies, and case studies to construct a multidimensional analytical framework. This diversified methodological approach, proven effective for complex subjects, aligns with strategies used by other scholars in studies of virtual identities (Rani, 2022; Mitrushchenkova, 2023). Acknowledging the inherent limitations due to the expansive scope of our analysis, this paper seeks to catalyze further interdisciplinary dialogue and research. It is envisioned that future studies will build on this groundwork to provide more profound analyses and robust solutions.

2. Literature Review

The investigation of Identity represents a crucial philosophical inquiry into human existence. At a fundamental level, Identity encompasses personal details about who they are such as name, age, gender, place of origin, and nationality. However, the Cambridge Dictionary expands this definition to include it as "the fact of being, or feeling that you are, a particular type of person, organization, etc.; the qualities that make a person, organization, etc. different from others"¹. This broader perspective aligns with philosophical explorations of the 'Self', epitomized by questions like "Who am I? Where do I come from? Where am I going?" (Mitrushchenkova, 2023). Historically, philosophers like Aristotle have recognized that Identity is shaped both biologically and socially—humans are not merely biological entities but also subjects within social contexts (Mitrushchenkova, 2023). In contemporary discourse, the concept of Identity has gained significance with developments in psychiatry, psychology, and

sociology. For example, Turkle (1995) in "Life on the Screen" pioneered the exploration of the relationship between technology and identity by investigating how digital technologies interpret and describe human behavior. Since then, extensive research shows that digital technologies not only shape our identities but also influence how we interact with them (Turkle, 1999; Thorne et al., 2015; Adhianto et al., 2019; Hoehe and Thibaut, 2020; Golubeva, 2020; Rani, 2022; Romeo, 2024). Later, Ching and Foley (2012) in "Constructing the Self in a Digital World" argues that Identity is a dynamic framework and an continuously evolving, fluid process within digital contexts. Digital technologies such as blogs, social networks, and virtual worlds, not only facilitate the exploration and expression of our identities but also actively shape them. Research focusing on platforms like Facebook illustrates how these tools enable users to overcome physical limitations, thereby enabling the creation of identities that would otherwise be unattainable (Zhao et al., 2008; Gardner and Davis, 2013). Moreover, emerging technologies such as virtual reality (VR), augmented reality (AR), artificial intelligence (AI), and blockchain—key components of metaverse technologies—radically transform our perceptions, experiences, and interactions with the world (Lee et al., 2021; Mystakidis, 2022; Lee et al., 2023b; WEF, 2024). As the distinction between digital and real-world identities becomes increasingly indistinct, understanding the interaction between digital and real-world identities, as well as the changes brought to them by the metaverse, is paramount.

Compared to the Internet, the metaverse provides a more immersive, authentic, and diverse digital lifestyle, enabling users to engage with the digital world in ways that closely mimic real-world experiences (Mystakidis, 2022; Lee et al., 2023b; Yang et al., 2024a; Bradley and Muñoz, 2024). For instance, within these virtual environments, users can project multidimensional information—such as preferred physical traits, natural movement habits, and genuine emotional states—through their digital avatars, thereby presenting themselves in a more vivid and three-dimensional manner (Lee et al., 2023b; Roblox, 2023). the metaverse transforms identity from a mere concept to a lived experience, highlighting the need for a delicate balance between self-expression and privacy protection (Ball, 2020). In the real world, identity encompasses diverse facets such as race, age, occupation, culture, hobbies, gender identity, and sexual orientation, which are crucial for self-presence, self-expression, and pride. Yet, these same attributes can also expose individuals to risks such as bullying, harassment, stalking, discrimination, litigation, legal actions, persecution, deception, or bias (WEF, 2024).

Identity in the metaverse inherits this duality from the real world, yet it becomes even more complex. the metaverse provides users with a creative space unrestricted by physical rules, allowing them to interact with other individuals and environments across various dimensions (Lee et al., 2021; Wider et al., 2023). This freedom enables

¹<https://dictionary.cambridge.org/dictionary/english/identity>

users to craft unique digital experiences, unleash creativity, and rethink their achievements, desires, and identities (Mitrushchenkova, 2023). However, the complexity of identities in the metaverse emerges not only from their multi-layered nature but also from their dynamic evolution and diversity. Users can choose to present different identities in various virtual environments and even continuously adjust and change identity characteristics within the same environment (Mitrushchenkova, 2023). Such fluidity and plasticity offer users unprecedented freedom of self-expression but also pose significant privacy and security challenges (Ball, 2020; WEF, 2024). Neglecting identity consideration in the metaverse can restrict the range of social interactions and degrade the overall user experience, as it limits the ability to represent individuals diversely and safely (Hennig-Thurau et al., 2022; Al-kfairy et al., 2024; Bradley and Muñoz, 2024). Furthermore, from a policy and governance perspective, overlooking identity nuances or novel characteristics in the metaverse risks reinforcing existing hegemonic norms and anthropocentric biases, thereby perpetuating real-world biases into the metaverse. This not only impacts technology design and its intended users but also influences the societal norms and values that these technologies reinforce and propagate (Al-kfairy et al., 2024; WEF, 2024).

Metaverse Identity, akin to the broader concept of Identity, is a multi-layered and multi-dimensional construct that has been examined from various disciplinary and perspectives in the literature. It is predominantly considered a foundational term that underpins discussions across diverse topics in specific disciplines, such as philosophy (Spence, 2008; Van der Merwe, 2021; Barbara and Haahr, 2022; Mitrushchenkova, 2023), psychology (Barbara and Haahr, 2022; Kim et al., 2023; Yang et al., 2024b), technology (Falchuk et al., 2018; Yang et al., 2023; Wang et al., 2024; Zichichi et al., 2023; Tao et al., 2023), management (Banaeian Far and Hosseini Bamakan, 2023; Wang and Wang, 2023; Truong et al., 2023; Bao et al., 2024), and law (Cheong, 2022; Mitrushchenkova, 2023; Wu and Zhang, 2023), which address issues and propose targeted solutions. Current research on Metaverse Identity can also be analyzed from multiple perspectives. The representation perspective treats it as the user’s avatar in the metaverse, focusing on visual representation and interaction (Spence, 2008; Lee et al., 2021; Park and Kim, 2022b; Saker and Frith, 2022; Šímová et al., 2023; Lee et al., 2023b,a). The data perspective considers it as the user’s digital footprint and data aggregation, emphasizing data properties and the extraction of value, including specific identifiers, credentials, and biometric elements (Falchuk et al., 2018; Yang et al., 2023; Zichichi et al., 2023; Tao et al., 2023). The social perspective views it through the lens of the user’s social roles and relationships within the metaverse, highlighting social attributes and their interactive effects (Calongne et al., 2013; Hollensen et al., 2022; Šímová et al., 2023; Yang et al., 2024b). The economic perspective defines it as the user’s economic entity and value

carrier, often linked to blockchain technology, with a focus on asset properties and transactional potential (Yang et al., 2022; Momtaz, 2022; Lee et al., 2023b; Truong et al., 2023; Tao et al., 2023; Wang et al., 2024). Although these perspectives are not entirely independent and exhibit some overlap, they collectively address the primary facets of the discourse. Some researchers adopt an integrative approach, viewing Metaverse Identity as an extension of real-world identity into the virtual realm, thus emphasizing its multifaceted nature (Saker and Frith, 2022; Barbara and Haahr, 2022; Won and Davis, 2023). This array of perspectives, while not exhaustive, forms the core of the scholarly discourse on this subject. However, research specifically focused on the structured framework and principle of Metaverse Identity on its intrinsic characteristics and impacts remains limited. Establishing such a framework and principle is strategically significant, as recognized by WEF, because it facilitates consensus among a broad range of stakeholders and provides guidance for responsible development in the metaverse.

Under this context, WEF emphasize that Metaverse Identity is an extension of identity as it is known today, encompassing representation, data, and identification (ID). Representation in the metaverse transcends traditional static profile pictures to include customizable digital assets such as avatars, AR filters, and accessories. These elements reflect various identity aspects from cultural attire to abstract designs, blending physical and digital worlds across 2D screens, AR, and MR. Data points, enhanced by artificial intelligence/machine learning models, are capable of describing and generating identity. They achieve this by analyzing user interactions, movements, and preferences, capturing current activities, predicting future actions, and shaping perceptions. ID systems have evolved from traditional methods like passports and driver’s licenses to unique avatar designs, body-based attestations, or virtual signatures. These innovations validate existence and grant access to specific realms or activities within the metaverse. WEF also note that these three components extend beyond a tangible human to include other digital entities such as chatbots, avatars, and digital replicas. These entities exhibit varying levels of interaction, autonomy, and behavior within digital experiences, playing vital roles in enabling and enhancing digital interactions (WEF, 2024). While this framework significantly deepens our understanding of the structural elements of Metaverse Identity, it still lacks the principled guidance necessary for effectively understanding intrinsic characteristics as well as its broader impacts and challenges. This research aims to bridge this gap.

3. Core Principles of Metaverse Identity

This section initiates with the review of recent cases that have garnered significant attention, which represents the manifestations and ramifications of Metaverse Identity. Drawing upon these case analyses and the literature

review, we articulate two guiding principles essential for comprehending the intrinsic characteristics, broader impacts, and challenges associated with Metaverse Identity. The first principle asserts that understanding and analyzing Metaverse Identity should adhere to behavioral norms that mirror, or are identical to, those in the physical world, emphasizing its importance in emotional experiences, cognitive perceptions, and economic interests. This principle not only facilitates a nuanced understanding among stakeholders of how identities are constructed, expressed, and perceived within the metaverse but also serves as a foundation for establishing norms and safeguarding rights inherent to these identities. The second principle highlights the dynamic and evolving nature of identity within the metaverse, shaped by interactions and mutual evolution, and underscores the unique role of Metaverse Identity in self-perception and the pursuit of values. By emphasizing the metaverse’s capacity for enabling diverse identity expressions and fostering social inclusiveness, this principle prompts stakeholders to develop adaptable and responsive frameworks that protect users’ identity rights while encouraging diverse expressions and creative innovations, thereby ensuring the metaverse’s growth without overly restrictive regulations.

3.1. Equivalence and Alignment

In recent years, the incidence of sexual assaults within the metaverse has become as a pressing concern, presenting complex social and legal dilemmas (Schulenberg et al., 2023; Lee et al., 2023b; Bellini, 2024). For instance, in December 2021, a female Metaverse user reported that three male avatars had ‘touched her[her avatar] inappropriately’ (Clayton, 2022). Another disturbing incident occurred in April 2022, when a female user from Japan shared via Twitter her experience of being attacked and virtually raped in VRChat while she was asleep (Anonymous, 2022). Additionally, the Daily Mail in the UK highlighted a particularly alarming case in January with its headline “British police probe Virtual Rape in metaverse: Young girl’s digital persona ‘is sexually attacked by gang of adult men in immersive video game’ - sparking the first investigation of its kind and questions about extent current laws apply in online world” (Camber Rebecca, 2024). The incident involved a British girl under the age of 16 whose avatar was raped by multiple avatars controlled by strangers during a virtual-reality game, leading to the first global investigation of such behaviors and raising significant legal inquiries regarding the applicability of existing laws in the metaverse.

At first glance, these cases may seem to involve merely disputes over unethical conduct and criminal actions, along with attendant legal applicability issues. However, a deeper analysis reveals that they fundamentally reflect profound challenges associated with identity recognition in the metaverse (Cheong, 2022; Kasiyanto et al., 2022; Wu and Zhang, 2023; Lee et al., 2023b). The reason these

incidents of sexual assault attract world-spread social attention and provoke strong reaction lies in the deep psychological identification that individuals have with their avatars (Lee et al., 2023b). If avatars were merely considered gaming tools or entertainment elements, violations against them would not significantly impact users in reality. Nevertheless, the victims’ report of discomfort and psychological trauma suggest a profound association between their avatar and their identities. This strong identification means that harm inflicted on an avatar is perceived as harm to the self, eliciting genuine emotional and psychological responses (Lee et al., 2023b). The legal disputes triggered by these cases also underscore the unique nature of metaverse identities in both legal and social contexts. While violations of personal rights in the physical world inevitably entail legal repercussions, in the metaverse, the identity attributes of avatars remain defined, leading to ambiguities in rights protection (Lee et al., 2023b; Bellini, 2024). This ambiguity necessitates a redefinition of the identities represented by avatars. Such incidents of ‘sexual assault’ not only reveal the high degree of integration between avatars and users’ self-presence—a psychological state in which people equate their virtual selves with their actual selves (Lee et al., 2023b)—but also demonstrate the significant influence of metaverse identities on real-life identity, highlighting the close connection between the metaverse and real life.

It is critical to acknowledge that the identity dilemmas triggered by these ‘sexual assault’ cases represent just one of the numerous challenges posed by metaverse entities in the metaverse. OpenAI’s recent release of ChatGPT-4o², an AI chatbot capable of human-like interaction, introduces a novel and complex dimension of challenges for identity recognition in the metaverse (Hsu, 2024). In this context, we propose the core principle - Equivalence and Alignment for conceptualizing and governing Metaverse Identity. Alignment refers to the consistency between metaverse identities and real-world identities concerning behavioral norms, social guidelines, and ethical standards. Equivalence emphasizes the parity between the two in aspects such as behavioral patterns, emotional experiences, cognitive perceptions, and economic interests (Lee et al., 2023b). Essentially, Alignment mandates that metaverse identities adheres to the same standards as real-world identities, while Equivalence underscores that the impact of virtual identities on users is as significant as that of real-world identities. We aim to simplify the complex attribute of Metaverse Identity through this principle, providing a clear and straightforward framework for developing metaverse identities. The principle also underscores the unique status of Metaverse Identity in contemporary legal and social contexts in metaverse era compared to in internet era, indicating the necessity of refining relevant regulations in the physical world. Furthermore, we intend to offer princi-

²<https://openai.com/index/hello-gpt-4o/>

pled recommendations for policymakers, technology developers, and platform operators. While striving for deeper immersion and realism in the metaverse, it is imperative to prioritize the recognition and protection of user identities, thereby guiding necessary regulation and ethical oversight at the intersection of technology and ethics.

3.2. Fusion and Expansiveness

Hatada et al. (2024) recently published their study "Avatar Robot Cafe," which explores how individuals with disabilities employ robots, avatars and a hybrid cyber-physical environment to redefine their identities. In this study, seven participants with disabilities provided remote customer service at a café near the University of Tokyo using a combination of robots and personalized avatars. The results demonstrated that the avatars enabled participants to shift their identities during and after customer interactions. The study utilized longitudinal semi-structured interviews as one method to document these identity transformations. In the paper, participant P2, diagnosed with somatoform disorder, contrasted her experiences when represented by a robot and an alpaca avatar. While using the robot, P2 felt obligated to maintain professional behavior, adhering to the belief that "failure is not an option." Conversely, when represented by the alpaca avatar, she experienced greater freedom, allowing her to adopt more playful behavior and consequently becoming a favorite among customers. P2 noted, "With the alpaca, I can tell myself, 'It cannot be helped because I am just an alpaca.' I cannot do that with OriHime (the robot)." She added, "When a customer says to my avatar, 'P2, go for it!' I enjoy it because it makes me feel like I am accomplishing what I should do as an alpaca. Just walking on two legs makes me feel proud." P2 relished interacting with others as an alpaca and greatly enjoyed her identity transformation. Participant P3, who has cerebral palsy and uses a wheelchair, identifies himself as biologically female but has a fluid gender identity (male or X). P3 created an anime-style character perceived as male or gender-neutral, aligning with his gender preferences and pronouns. Typically subjected to perceptions of being "small and cute" due to his high-pitched voice and physical appearance, P3 noted significant shifts in how others treated him when using a taller, masculine avatar. This shift in perception facilitated a transformation in his self-expression, moving from the neutral Japanese first-person pronoun "watashi" to the more masculine informal "ore," and adopting a less direct but more assertive communication style. P3 described this as "finally becoming a boy," highlighting the profound impact of the avatar on his identity perception.

The Avatar Robot Cafe The Avatar Robot Cafe case offers valuable insights into the intricate nature of metaverse identities. In this scenario, avatars serve as powerful tools that allow individuals to reshape their self-identity, transcend physical limitations, and engage more fully in social activities. For individuals with disabilities in this case, avatars facilitate a novel identity experience and new

modes of social interaction. As the metaverse continues to evolve, we believe that more such scenarios will emerge, allowing a broader and more diverse group of people to have similar experiences. These scenarios represented by this case lead us to propose the second core principle of Metaverse Identity: Fusion and Expansiveness. In the metaverse, Fusion refers to the profound integration of metaverse and real-world identities, creating an intertwined and mutually constructive holistic self. The metaverse identity articulates needs, desires, and values that may be unexpressed or inexpressible in the real world, thus acting as an extension and expansion of the real-world identity. Conversely, the real-world identity provides foundational support for the metaverse identity, with both complementing each other. Expansiveness underscores the unprecedented possibilities for diverse expression and the infinite extension of identity in the metaverse. Individuals can transcend their inherent traits and conditions, crafting rich and varied alternative identities to present themselves in different forms and fulfill diverse needs, such as social interaction and self-realization. As illustrated by participants P2 and P3 in the Avatar Robot Cafe case, who manifested new selves through an alpaca and a masculinized anime character respectively, the openness and inclusivity of the metaverse allow marginalized groups to break free from identity confinements and gain equal participation opportunities. The Fusion and Expansiveness principle further elucidates the complexity and significance of constructing identities in the metaverse. Metaverse identities are not merely collections of digital representation, data, and IDs (WEF, 2024), but are authentic reflections of an individual's cognition, awareness, and socio-cultural interactions. They complement and shape the subjectivity of individuals in the metaverse-era alongside real-world identities. Furthermore, they underscore the emancipatory potential of the metaverse for individuals, emphasizing how the openness, plasticity, and fluidity of identity, empowered by technology, not only offer boundless possibilities for higher-dimensional self-realization but also hold revolutionary potential for promoting social equity and fostering a diverse, inclusive ecosystem.

It is noteworthy to recognize the principles of Equivalence and Alignment and Fusion and Expansiveness are complementary rather than contradictory. Equivalence and Alignment emphasizes the congruence and parity between metaverse and physical-world identities concerning behavioral norms and rights protection. This principle acts as a normative foundation, ensuring that metaverse identities do not become havens for evading responsibilities or violating others' rights, thereby providing an essential ethical and legal framework for the integrating the metaverse and physical-world identities. Fusion and Expansiveness, on the other hand, highlights the dynamic interplay and mutual evolution between metaverse and physical-world identities through their interaction. It emphasizes the unique role of metaverse identities in shaping self-conception and pursuing values, highlighting their po-

tential for creativity and agency. This principle serves as a catalyst for the multifaceted development of individuals and the advancement of social inclusivity. Therefore, in the governance and development of metaverse identities, it is imperative to uphold Equivalence and Alignment to regulate and guide behaviors in the metaverse, while also leveraging the potential of Fusion and Expansiveness to allow extensive exploration of identity and value creation. This dual approach necessitates the establishment of clear boundaries and behavioral guidelines for metaverse and real-world identities when formulating pertinent policies and regulations, while preserving sufficient flexibility and openness to encourage the expression and integration of diverse identities, thereby fostering social inclusivity and innovation. Only through the dynamic equilibrium of these two principles can we realize a synergistic interaction between digital and real coexistence, ensuring the orderly operation of the metaverse ecosystem while unlocking the positive potential of technological advancement.

4. Critical Challenges of Metaverse Identity

Building upon the emblematic case analyses, we have identified two core principles—Equivalence and Alignment and Fusion and Expansiveness—to provide principled guidance necessary for effectively understanding the intrinsic characteristics and broader impacts of metaverse identities. This section will address the critical challenges that demand immediate attention, supported by these two principles. Firstly, under the principle of Equivalence and Alignment, we explore three pivotal challenges: identity interoperability, legal boundaries, and privacy management. Secondly, informed by the principle of Fusion and Expansiveness, we investigate risks associated with deep-fakes & synthetic identities, and identity fragmentation. The elucidation of these five challenges serves to highlight key issues within metaverse identity systems, thereby encouraging further interdisciplinary research and exploration.

4.1. Identity Interoperability Challenges

Interoperability challenges are a critical obstacle to the development of the metaverse, as discussed by both academia and industry in recent years (Ball, 2022; Wang et al., 2022; WEF, 2023a). In the systematic literature review on metaverse interoperability, Yang et al. (2024a) emphasize that identity is the cornerstone of an interconnected Metaverse. Without a consistent and seamless identity transfer between the physical world and the metaverse, as well as across different platforms within the metaverse, true inter-connectivity remains unattainable. Equivalence and Alignment stress the consistency and equal status of metaverse identities and real-world identities in the terms of behavioral norms and rights protections. Just as our identities in the physical world can seamlessly transition, authenticate, and connect across different scenarios, metaverse identities should exhibit the

same fluidity. This is essential for the metaverse to be a true replica and extension of the physical world (Wang et al., 2022).

Following the three components framework (WEF, 2024), the current interoperable state of metaverse identity is as follows: At the identity representation layer, most metaverse platforms continue the practices of the internet era, requiring users to create separate avatars on different platforms (Jiang et al., 2023). At the data layer, users generate identity-related data such as personal attributes, social relationships, and behavioral records on various platforms, but this data is typically stored and managed in isolated silos by each platform (Wang et al., 2022), preventing effective cross-domain data management and sharing. Finally, at the identification layer, centralized methods dominate despite exploratory applications such as decentralized identity (DID) technologies, which remain immature stages with significant shortages (Alizadeh et al., 2022). This results in limited interoperability due to varying DID solutions across platforms, and the coexistence of centralized and decentralized methods complicates interconnected identification (Yang et al., 2024a), necessitating further resolution. These fragmented identities lack the unified digital identity mappings or authorization mechanisms, necessitating repeated customization and offering minimal support for mutual recognition and migration across platforms, which disrupts user identity consistency.

Although the nascent stage of the metaverse’s development is a primary factor contributing to these issues, it is imperative to consider the risks associated with path dependency in advance. The prevalent identity systems are predominantly centralized and designed around individual platforms, inherently lacking interoperability. Economic incentives often drive platforms to implement “walled garden” strategies, thus inhibiting the advancement of interoperability (Kerber and Schweitzer, 2017). Furthermore, the absence of mature technical standards and subsequent legal frameworks constrains progress in this domain. It is also essential to acknowledge that the principle of Fusion and Expansiveness underscore the diversity and dynamic nature of metaverse identities, which can lead to more complex scenarios due to interoperability challenges.

To overcome the barriers to these challenges, coordinated efforts across technological, institutional, and industrial dimensions are essential. Firstly, it is imperative to expedite the establishment of comprehensive norms and standards that ensure identity interoperability within the Metaverse. INTERPOL (2024) advocates for the consideration and implication of a unique digital identity per person across multiple metaverses. The norms and standards should encompass not only the creation of identity, but also the related data storage and interfaces and authentication protocols. These measures are crucial for establishing a standardized technical framework that supports seamless identity interoperability within the metaverse. Secondly, legal and regulatory frameworks should

be established to clarify the rights and obligations of various representative identities across different contexts, balancing the development of interoperability with privacy and security, and ensuring compliant data flow. Additionally, enhancing governance mechanisms by mobilizing platform enterprises, industry organizations, and regulatory bodies is necessary. This can be achieved through a multi-stakeholder identity trust alliance to foster robust collaboration in building interoperability. Lastly, fostering a healthy industry ecosystem around metaverse identity interoperability is essential. This includes creating data-sharing incentive mechanisms, conducting interoperability privacy certifications, and enhancing public education to increase user awareness.

4.2. Legal Challenges of Identity in Metaverse

As the metaverse continues to evolve and its applications expand, the challenges to legal boundaries become increasingly evident. In the cases of sexual assault discussed previously, the victims experienced substantial psychological harassment. Current legal frameworks, however, find it difficult to enforce traditional accountability and sanctions due to the lack of physical contact (Cheong, 2022; Lee et al., 2023b; Bellini, 2024). The report, "Sexual Violence and Harassment in the Metaverse: A New Manifestations of Gender-Based Harms," underscores the urgent need for updated national and international law enforcement to address this distinct form of metaverse-facilitated sexual violence and harassment (Rigotti and Malgieri, 2024). With avatar-based interactions becoming commonplace in the metaverse, the frequency of such rights conflicts and illegal acts is expected to rise. Actions that would typically incur legal penalties in the real world, from civil liabilities like negligence and harassment to criminal offenses such as assault and theft, pose significant challenges in virtual settings of metaverse. The applicability and efficacy of existing laws within these virtual contexts are subjects of ongoing significant debate (Cheong, 2022; Lee et al., 2023b).

The continued advancement of artificial intelligence technologies, exemplified by models such as ChatGPT-4o, is leading to the emergence of increasingly complex digital entities, thereby escalating the challenges to existing legal frameworks. In September 2023, a court in South Korea sentenced an individual to two and a half years of imprisonment for utilizing AI technology to produce highly realistic virtual child pornography (Bae and Yeung, 2023). This landmark ruling, which is the first of its kind in South Korea, has attracted widespread international attention. The prosecution contended that the depiction of virtual characters, despite their fictitious nature, constituted a criminal act due to their lifelike portrayal of children (Bae and Yeung, 2023). This case has significantly blurred the boundaries between real and virtual entities, equating virtual characters with real children in legal considerations.

Digital entities are redefining the concept of identity, extending it beyond physical individuals. These entities, capable of representing humans, demonstrate varied levels

of interaction, autonomy, and behavioral expressions in the metaverse. They can emulate human communication and serve in roles such as virtual assistants, companions, or social media influencers (WEF, 2024). For example, the Hong Kong University of Science and Technology has pioneered the use of AI-based digital personas, such as a simulation of Albert Einstein, to function as virtual lecturers in its metaverse classroom (HKUST, 2024). These entities transcend mere code or graphical representations; they interact with, influence, and sometimes represent individuals or organizations.

Existing legal frameworks struggle to address issues of identity recognition, behavior evaluation, and accountability when these entities engage in detrimental activities (WEF, 2024). One proposed solution from the academic realm to address the challenges posed by digital entities is to grant them the status of legal personhood, thus holding them accountable for their actions within the metaverse (Kurki, 2019). This would involve incorporating rights and responsibilities for these entities within the existing legal framework and granting them the capacity to be party to legal proceedings, which introduces significant complexity. Key issues include defining legal standards for the recognition of digital entities and managing the effects of their actions on both their controllers and other stakeholders, necessitating innovative legal and policy responses (Cheong, 2022).

Drawing on the principles of Equivalence and Alignment, and paralleling real-world legal structures, could provide a feasible approach. Scholars such as Kasiyanto et al. (2022) assert that cybercrimes within the metaverse, including stalking, assault, child exploitation, kidnapping, violations of intellectual property, and financial fraud, should be subject to legal repercussions analogous to those enforced in the physical domain. They advocate for the implementation of established legal procedures from the physical world by metaverse law enforcement agencies to address these offenses effectively. Furthermore, certain scholars propose extending the regulatory frameworks applicable to corporate entities to digital entities within the metaverse, thereby applying well-established corporate governance principles to forge an appropriate regulatory environment (Day, 2009; Lake, 2019; Osborne, 2021; Cheong, 2022). Furthermore, WEF advocates for the clear identification of digital entities, distinguishing between those driven by humans and artificial intelligence, and establishing a robust mechanism for fault liability (WEF, 2024). As metaverse technologies advance and the convergence of virtual and real worlds becomes more pronounced, the projection and extension of individual identity elements into virtual spaces will escalate, intensifying legal challenges. This evolving scenario demands ongoing exploration and refinement of legal strategies (Cheong, 2022).

4.3. Privacy and Identity Management Challenges

The metaverse presents unprecedented challenges to user privacy. A study by Nair et al. (2023a), involving over 50,000 players of the popular VR Game 'Beat Saber', highlights these concerns. Analysis of 2.5 million VR motion dataset through machine learning algorithms reveals that merely 100 seconds of data can uniquely identify a user with over 94.33% accuracy, and remarkably, only 2 seconds are needed to identify half of the users (Nair et al., 2023a). Further research indicates that this motion data can accurately infer a broad spectrum of personal characteristics, including bio-metric information such as height and wingspan, as well as demographic details like age and gender. It can even predict the user's country of origin and clothing type. Most concerning is the accurate capability to discern the presence of mental and physical disabilities (Nair et al., 2023b). This level of precision in identification intensifies when motion data are coupled with other tracked data within the metaverse. This situation suggest that anonymity in the metaverse may be impossible (Rosenberg, 2023).

Contrary to traditional privacy measures that do not necessitate sharing sensitive data like fingerprints, the metaverse inherently involves the dissemination of motion data—a fundamental aspect of interaction that must be shared in real-time with all participants. Furthermore, unique motion patterns analyzed across various contexts—be it professional environments, social interactions, or private setting—facilitate the straightforward identification of individuals. Additionally, the inherent link between our physical movements and our motion data allows machine learning algorithms to correlate VR actions with real-world surveillance footage, leading to potential real-world tracking and identification (Nair et al., 2024).

In summary, without the development of innovative protective measures, maintaining privacy in the metaverse could be an insurmountable challenge, presenting significant and potentially transformative implications for identity management. To effectively address the unique challenges the metaverse poses to privacy, targeted measures are necessary both technologically and at the policy level. From a technological standpoint, various sophisticated methods, including local epsilon-differential privacy, adversarial machine learning, Trusted Execution Environments (TEE), and Secure Multi-Party Computation (MPC), can enhance user privacy (Nair et al., 2024). However, these technologies can sometimes compromise user experience or remain underdeveloped (Nair et al., 2024). No comprehensive and fully mature technical solutions currently exist, underscoring the importance of establishing robust privacy regulations to complement and guide the development while fostering the development of privacy-enhancing technologies. Addressing the metaverse's unique privacy challenges requires a dual approach: continuously improving privacy-enhancing technologies to keep pace with the metaverse's rapid evolution, and developing targeted privacy protection measures tailored to its

immersive, three-dimensional nature. For example, governing privacy in three-dimensional spaces necessitates distinct data processing and privacy protection measures for public areas (akin to offices) and private spaces (akin to homes). Such differentiation is crucial to ensure that privacy regulations in the metaverse reflect varying real-world privacy expectations, adhering to the principle of Equivalence and Alignment. By adopting this nuanced approach to privacy governance, we can foster a more secure and trustworthy metaverse that respects users' privacy rights while promoting innovation and growth.

4.4. Challenges of Deepfake and Synthetic Identities

One development trend in the metaverse is to enhance user experiences by making them more realistic, integrated, and immersive (Gonçalves et al., 2022), illustrating the principle of Fusion. This trend manifests in several key areas: the application of advanced algorithms such as Generative Adversarial Network (GANs) has significantly enhanced the realism in rendering virtual avatars and digital entities (Tewari et al., 2020; Saxena and Cao, 2021; Teotia et al., 2024; Koh et al., 2024). Innovative methods by researchers in facial expression (Gonzalez-Franco et al., 2020), motion capture (Jung et al., 2022), and behavioral modeling (Ahuja et al., 2021) have similarly advanced the interactivity and authenticity of avatars and digital entities (Wen et al., 2021; Fysh et al., 2022). Moreover, there have been considerable advances in the generating and rendering of virtual environments (Wang et al., 2021; Fink et al., 2023). The rapid evolution of AI, particularly in the field of generative AI, has simplified the creation of highly realistic, indistinguishable digital content, thus enhancing the immersive experience of the metaverse (Ramalingam et al., 2023; Murala and Panda, 2023; Qayyum et al., 2024).

However, this technological advancement also poses significant security risks, such as the potential for creating deepfakes or synthesizing untraceable identities, thereby raising serious security concerns (Tariq et al., 2023; Wu et al., 2023). Deepfakes, manipulated media created using AI and deep learning designed to deceive viewers, have become increasingly prevalent, sparking significant societal discussion (Mirsky and Lee, 2021). For instance, in 2023, an AI-generated image of the Pentagon explosion went viral, temporarily impacting the U.S. stock market (Alba, 2023). Generative AI is transforming the creation and expression of digital media content, while the metaverse is poised to redefine the mechanism of content distribution of content distribution, experience, and interaction (Alba, 2023; WEF, 2023b). It is anticipated that the integration of AI with VR and AR technologies will magnify their impacts within the metaverse (WEF, 2023b). These technologies facilitate the creation of hyper-realistic simulations, the development of digital entities and scenes, and enable deeper, more emotionally resonant interactions between users or with digital entities.

Consequently, this technological expansion broadens the scope of threats like deepfakes (Tariq et al., 2023; Wu et al., 2023). In the absence of stringent regulatory oversight within the metaverse, users might exploit personalized identity markers—such as those derived from actual facial features and body forms—to commit identity theft or create synthetic identities. This poses significant risks of severe security and privacy violations, potentially leading to more profound forms of deception, defamation, and threats within the metaverse. For instance, the application of deepfake technology in virtual workplaces to fabricate digital clones of supervisors or colleagues could undermine internal trust, induce confusion by issuing deceptive work directives, or facilitate the dissemination of misinformation or propaganda, thereby impacting critical decisions (Tariq et al., 2023). Regrettably, existing deepfake detection methodologies are primarily tailored to address content in the physical world, such as images and videos, and do not yet adequately account for the unique challenges presented by the metaverse (Tariq et al., 2023). According to Wu et al. (2023), there is a pressing need for deepfake recognition and prevention mechanisms specifically designed for the metaverse. Looking forward, addressing these challenges will necessitate a dual approach: the development of robust technological solutions for identity verification and content authenticity, and the establishment of clear regulatory frameworks that delineate legal boundaries for virtual avatars/digital content and address critical issues such as privacy protection and misuse prevention. Only through a coordinated effort can the metaverse be ensured to be a relatively safe and trustworthy virtual space.

4.5. Identity Fragmentation and Psychological Well-being Challenges

The principle of Expansiveness elucidates that the metaverse offers unparalleled opportunities for diverse and expansive identity representation, enabling individuals to transcend the limitations associated with physical world. While this diversity in representation can enhance creativity and inclusivity, as exemplified by the Avatar Robot Cafe (Hatada et al., 2024) case where marginalized groups gained equal participatory opportunities, it also poses significant risks such as identity fragmentation and confusion. Recent research by Yang et al. (2024b), involving a two-wave panel study on the VRChat platform, corroborates these concerns, indicating that while expansion of identity representation can boost self-esteem and life satisfaction, it may compromise these benefits when it leads to inconsistencies in self-concept. A poignant historical example is the 2000 incident where a child, after prolonged engagement with a video game, began to experience severe identity dissonance. Believing himself to be the game’s protagonist, he ventured out at night to “fight enemies and save the princess,” mimicking the game’s narrative. This blurring of reality and fantasy necessitated medical intervention, to help reorient his sense of identity and reality (Banerji, 2023).

As the metaverse progresses, addressing these psychological impacts and implementing protective measures for identity integrity, particularly among children and vulnerable populations, becomes imperative. Identity fragmentation within the metaverse can significantly impair users’ mental health and social relationships. The ability to easily create and switch between diverse, unintegrated identities may reduce reliance on real-world personas, exacerbating identity fragmentation issues (Yang et al., 2024b). These ‘consequence free’ virtual spaces (Turkle, 1999), which may diverge sharply from reality, pose specific risks. Such environments can lead to self-disalignment, where users perceive their virtual identities as superior, increasing their engagement with virtual communities and causing alienation from the physical world (Banerji, 2023). This alienation can compel individuals, particularly children and adolescents, to increasingly immerse themselves in the metaverse, potentially leading to social withdrawal, depression, and antisocial behavior (Koohsari et al., 2023). Considering the known adverse effects of social media, video games, and mobile devices, the immersive and escapist nature of the metaverse requires careful scrutiny to prevent its potentially detrimental impacts on psychological and social well-being (Banerji, 2023; Koohsari et al., 2023).

Research on multiple cultural identities has shown that the mere presence of multiple identity representations is not inherently problematic; rather, the critical factor is relationships, integration and management of these identity representations (Yang et al., 2024b). As the metaverse evolves and identity-related issues become more pronounced, further research and practical interventions are essential. Future studies should focus on assisting users in managing their multiple identity representations and preventing identity fragmentation to mitigate associated psychological and social challenges. Given that these concepts are still in their nascent stages, proactively recognizing and preparing for identity fragmentation is crucial for addressing the emerging challenges of the metaverse effectively.

5. Conclusion and Limitation

The metaverse, an emerging realm that merges virtual and real elements, significantly influences identity expression, social interaction, and human development trajectories. Central to the metaverse is the construction of identity, which involves representation, data management and identification of avatars and other digital entities (WEF, 2024). These elements are intimately connected to users’ sense of belonging, privacy, security, and trust. Despite its significance, scholarly research on metaverse identities is still nascent and lacks a comprehensive theoretical framework. This paper conducts a critical review of the existing literature to explore the Metaverse Identity concept from both multidisciplinary and perspective viewpoints, identifying the research gap. Unlike traditional internet

settings, the metaverse offers more immersive and varied experiences, transforming identity from a mere theoretical construct into a tangible, experiential reality. This shift accentuates the tension between self-expression and privacy protection.

Metaverse identities are characterized by their multi-layered, dynamically evolving, and diverse nature, which grants users unprecedented freedom in self-expression but also poses substantial privacy and security risks. Addressing these complexities, this paper proposes two core principles: Equivalence and Alignment and Fusion and Expansiveness. The first principle argues for consistency between metaverse and real-world identities in terms of behavioral norms and social standards, which is essential for developing conduct guidelines and protecting rights. The second principle stresses the need for deep integration and extensive expansion of metaverse identities, breaking beyond real-world constraints to meet diverse needs and promote inclusive participation. Effective governance in the metaverse necessitates a dynamic balance between these principles, ensuring fairness while encouraging diverse expressions and innovative developments. Our analysis identifies five key challenges to the development of metaverse identities: interoperability, legal boundaries, privacy and identity management issues, and the risks associated with deep fakes & synthetic identities, and identity fragmentation impacting psychological health. Building on the principles outlined, this paper offers strategic recommendations to address these challenges.

However, this study exhibits several significant limitations. Firstly, the representativeness of the case studies needs enhancement. This paper discusses instances such as virtual sexual assault and Avatar Robot Cafe, yet the case selection is narrow and largely confined to specific scenarios. Given the metaverse's diverse and complex ecosystem, our analysis might not fully capture the spectrum of identity practices. Future research should broaden the scope of case studies to improve the findings' generalizability and relevance. Secondly, the empirical foundation of this study requires strengthening. Metaverse identity research, still in its infancy, largely lacks comprehensive data on user behavior and psychological responses. Currently supported primarily by literature review and qualitative analysis, this study highlights the need for more rigorous empirical research. Future efforts should include observational, survey, and experimental methodologies to explore identity construction behaviors and perceptions in the metaverse more deeply, thereby solidifying the theoretical framework. Lastly, the theoretical principles introduced—Equivalence and Alignment, and Fusion and Expansiveness—need further refinement and operationalization. While these principles offer valuable insights for regulating identity in the metaverse, they are proposed from a broad perspective and remain abstract. The practical application and policy-making processes might encounter challenges in operationalizing these principles. Future research should refine these two principles and develop

more detailed, actionable guidelines to inform the governance and design of metaverse identity framework.

Looking forward, the metaverse, as an emerging socio-technical ecosystem in the digital age (Lee et al., 2021; Wang et al., 2022; Lee et al., 2023b), is poised to significantly transform human life and developmental practices. The manner in which individuals construct and manage their identities between the physical world and metaverse is critical for sustainable human development. Addressing this issue requires a unified approach from academia, industry, and policy sectors to promote sustained interdisciplinary and multi-perspective research, aimed at fostering a robust and inclusive metaverse environment. Such collaborative initiatives are essential to provide both intellectual and practical contributions to the evolution of this new era.

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