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Traversing the Metaverse: the new frontiers for computer-mediated communication and natural language processing

Przemierzając metawersum: nowe granice w komunikacji zapośredniczonej przez komputer i w przetwarzaniu języka naturalnego

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Abstract
The primary objective of the following paper is to explore the concept of the Metaverse encompassing the Internet revolution, the information revolution, and the artificial intelligence technology revolution, which further incorporates virtual reality (VR), augmented reality (AR), and mixed reality (MR) technologies. Due to the fact that the current, fourth wave of computing innovation can be regarded as driven by immersive, spatial technologies, the Metaverse as the so-called post-reality universe and multi-user virtual environment has a considerable potential to become the future of the digital discourse. With Natural Language Processing (NLP) conceptualized as a subfield of artificial intelligence and linguistics, the following paper argues for the inclusion of NLP-based methods in the developing discourse revolving around the transformative idea of the Metaverse. At the same time, computer-mediated communication (CMC), can potentially be extended to the new context of the extensive online world of the Metaverse.
Keywords: metaverse, virtual reality, computer mediated communication, natural language processing, cyberspace, computational linguistics

Streszczenie
Głównym celem niniejszego artykułu jest przyjrzenie się koncepcji metawersum obejmującej rewolucję internetową, rewolucję informacyjną i rewolucję technologii sztucznej inteligencji, która obejmuje rzeczywistość wirtualną (VR), rzeczywistość rozszerzoną (AR) i rzeczywistość mieszaną (MR). W związku z tym, że obecną, czwartą falę innowacji komputerowych można uznać za napędzaną przez immersyjne, przestrzenne technologie, metawersum postrzegane jako uniwersum postrzeczywistości i wieloużytkownikowe środowisko wirtualne ma znaczący potencjał, by stać się przyszłością dyskursu cyfrowego. Poprzez umiejscowienie przetwarzania języka naturalnego (NLP) jako poddziedziny sztucznej inteligencji i językoznawstwa, niniejszy artykuł opowiada się za włączeniem metod NLP do rozwijającego się dyskursu dotyczącego transformacyjnej metawersum. Jednocześnie komunikacja zapośredniczona przez komputer (CMC), może potencjalnie zostać rozszerzona do nowego kontekstu rozbudowanego internetowego świata metawersum.
Słowa kluczowe: metawersum, rzeczywistość wirtualna, komunikacja zapośredniczona przez komputer, przetwarzanie języka naturalnego, cyberprzestrzeń, lingwistyka komputerowa

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1. Introduction

The so-called fourth wave of technologies is increasingly involved with the immersive aspect of technologies merging the digital reality with the physical one. In fact, the next transformative 'ubiquitous computing paradigm' (Mystakidis, 2022) is bound to be established. As stated by Mystakidis, this type of a paradigm is the Metaverse. The term 'metaverse' was first coined by Stephenson in a science fiction novel titled 'Snow Crash' (1992). Stephenson refers to the Metaverse as a parallel digital universe, the next stage of the Internet, in which users of a given virtual world embodied by avatars socialize in the online space while escaping from the dystopian reality. In recent years, the concept of the Metaverse has been conceptualized as an interconnected network of immersive digital environments accessed by the end-users with the use of virtual reality (VR) devices. Due to the fact that the Metaverse is in its early stages of development, the term itself lacks an all-encompassing, clear-cut definition. Despite the lack of a consensus about the precise usage of the term, in the scope of this article, the term 'metaverse' will be used to describe decentralized, interconnected 3D virtual environments driven by innovative technologies such as virtual reality, augmented reality and blockchain; a new kind of virtual space in which users socialize and interact in real-time in order to form a persistent, online cyberspace.

With the advent of the Metaverse, the construction of a three-dimensional reality has been enabled. Considering the transformative nature of the Metaverse, the concept itself can be seen as highly relevant in the discussions centered around cyberdiscourse. Zagalo et al. (2011) argue that virtual worlds can be perceived as 'built of symbolic bricks of signs and shapes; they are symbolic worlds of meaning-making and semioses' (Zagalo et al., 2011, p. 2, as cited in Matusitz, 2005). Similarly, Jensen et al. (2012) maintain that 'these new symbolic worlds of meaning-making flows' (p. 4) transform the way in which users 'mediated by avatars, digital objects' and text' (p. 4) traversing the virtual spaces perceive both the very sense of spatiotemporal and the idea of communication. It is further argued that the communication enabled by the emerging technological infrastructures in the Metaverse can be identified as a complex entity enriched by communication media including 3D virtual worlds, text, and advanced VR-based graphics. Hereby, the Metaverse with its orientation towards the user, decentralization, augmentation, and automatization is conceptualized as a manifestation of Web 3.0 and a new type of cyberdiscourse and cyber

literacy referred to as discourse 3.0. Multimodality in the virtual environment can arguably be considered as a starting point of mastering the interplay between varying codes in the context of virtual reality. Despite the fact that NLP-based methods in the Metaverse are still at their experimental stage, in the scope of this article, Natural Language Processing as a subfield of computational linguistics, computer science, and a branch of Artificial Intelligence (AI) can be seen as a field with a considerable potential of extending the Metaverse capabilities of replicating real-world experiences including natural language. Additionally, the concept of the Metaverse can be put in the context of computer-mediated communication (December, 1996) as a novel manifestation of CMC extending its definition to the interconnected virtual spaces. One can argue that the Metaverse constitutes the next stage of the evolution of the internet and digital space as such. On the whole, it can be argued that the Metaverse creates new frontiers for digital transformation, cyberdiscourses, natural language processing, and computer-mediated communication.

2. Digital transformation and digitalization: the rise of the Metaverse

In *Understanding digital transformation: A review and a research agenda*, Vial (2019) asserts that digital transformation (DT) on a macro level pertains to 'profound changes taking place in society and industries through the use of digital technologies' (p. 2). Following Vial's definition, digital transformation can be understood in terms of dynamic processes that bring about the transformation of paradigms through the employment of communication, computing, and connectivity technologies. From this perspective, the Metaverse can be seen as a mediating space between technology and cyberspace-based communication. Despite the fact that the Metaverse is still an emerging concept, its key components have started to revolutionize the very idea of cyberspace bringing the virtual one step closer to the ultimate digital transformation. Lee et al. (2022) claims that the current cyberspace has undergone a considerable transformation in the recent decade, with 'the latest attempts [at cyberspace evolution] proceeding to offer services and digital experiences to human users through virtual environments, such as Augmented Reality and Virtual Reality' (p. 1).

While the term 'digital transformation' refers to the overarching transformative processes built on emerging technologies, digitalization denotes a 'process in which many domains of social life are restructured around digital communication and media infrastructures' (Brennen & Kreiss, 2014). The Metaverse arguably can be perceived as a new manifestation of digitalization, with digital artifacts in virtual worlds and online Metaverse practices permeating society, language, and discourse. The most recent stage of digital transformation is linked to the decisive move towards Web 3.0 conceptualized as a user-centric decentralized network. Web 3.0 arises through new technologies including artificial intelligence, cryptocurrencies as well as virtual and augmented reality. As argued by Nath (2022), the Web 3.0 stage of Internet development is 'being driven by a shift in how we, as a society, view and value the Internet, which is being aided by new technologies' (p. 5). In delving into the nature of Web 3.0, Nath underlines the following characteristics as defining the most recent stage of the Internet evolution: semantic web, ubiquitous, decentralized nature, trustless governance system, blockchain technology, digital identities, and tokenization. It is crucial to underline the importance of the semantic web and language in the Web 3.0 evolution. In fact, the new iteration of the Internet intends to make the data machine-readable and 'rather than processing text [...] using processes similar to human deductive reasoning and inference' (p. 6). Although there exists a lack of consensus as to the position of the Metaverse within Web 3.0 innovations, it is assumed in this paper that the Metaverse owing to its user-oriented approach and decentralization can be seen as one of the phenomena interrelated with the emergence of Web 3.0.

3. Cyberspace and the virtual universe of discourse

Clark (2010) claims that cyberspace 'is the collection of computing devices connected by networks in which electronic information is stored and utilized, and communication takes place' (p. 1). According to Mbanaso and Dandaura (2015), cyberspace 'encapsulates the combination of the internet and telecommunications technologies that allow for the recording, storage, retrieval and transmission of information' (p. 2). From this perspective, cyberspace can be seen as a redefining space for between-user interactions, a space ultimately characterized by the technology-mediated interconnection of people (users) put in the context of advances in the communication and information technologies. The term cyberspace refers to the non-space world in which the interaction between virtual presences occurs through

artificial realities. In the scope of this article, the Metaverse can be understood as 'the next progressions of cyberspace featured by immersiveness [immersive cyberspace]' (Lee et al., 2022). The so-called digital discourses apply to 'texts and interactions in digitally mediated contexts' (Hafner, 2018, p. 1). In discussing emerging digital discourses Tannen and Trester (2013) outline the idea of discourse 2.0 rooted in the concept of the Web 2.0 referring directly to the second stage of the Internet development oriented towards user-generated content in which a greater level of user interactivity manifested in social media platforms is put forward. Due to the fact that the emergence of the Metaverse marks the accelerated evolution of the Internet, it is assumed that the Metaverse can be seen as an indication of an emerging discourse 3.0, particularly in the light of the argument that the Metaverse can be perceived as a phenomena related to Web 3.0.

The field of digital discourse analysis refers to the 'shift of focus from medium-relate to user-related patterns of language use' (Androutsopoulos, 2006). As was stated in the sections above, the Metaverse can be seen as user-centric; thus, the definition of a digital discourse as the investigation of user-related language might be perceived as relevant. Furthermore, Jones and Hafner (2021) argue that the so-called digital literacies refer to 'the practices of communicating, relating, thinking and being associated with digital media' (p. 17). Furthermore, not only are digital literacies related to the use of digital spaces but also to 'the ability to use them to accomplish particular social practice' (p. 17). Bearing in mind the idea of digital literacies, the spatiotemporal situation of the interaction is ultimately moved from the physical world to cyberspace. In this sense, the Metaverse can be positioned as a digital literacy owing to its use of the digital space to allow for social practice. In *Unified Discourse Analysis*, Gee (2014) proposes the concept of the 'universe of discourse' defined as 'the set of objects and their properties that we take to exist in a given domain' (p. 44) to analyze the discourse present in video games. Even so, basing on the close interrelatedness of video games and the Metaverse, the concept of the universe of discourse can be further extended to the decentralized, online virtual worlds. As maintained by Gee (2014), a game's universe of discourse denotes a 'set of things, characters, and an avatar as affordances for and explanations for action' (p. 45). It is crucial to underline the importance of avatars in the unified discourse analysis proposed by Gee; in the Metaverse, avatars can be seen as vehicles for end-

users to embody in order to interact with cyberspace and interact with other players' digital identities.

4. Multimodality of the Metaverse

Van der Maaten et al. (2022) from Meta AI argue for the inclusion of multimodal models in the further establishment of the Metaverse in order to facilitate the tracking of multiple modalities including speech, text, and images. It is argued that the integration of multimodal models with the immersive technologies of VR, AR, and MR has the potential to lead to the emergence of 'more interactive, immersive, and smarter AI systems' (Van der Maaten et al., 2022) that can deal with the interaction of multiple codes in creating the virtual world environment. In describing the term 'multimodality', Jewitt (2014) states that multimodality can be used to denote ' a perspective, a methodological application or a field of enquiry [which] attends to the full repertoire of resources that people use to communicate and represent phenomena and experiences including speech, sound, gesture, gaze, body posture and movement, writing, image and so on' (p. 127). Therefore, it is not the language itself that is perceived as the basis of meaning.

Chaume (2012) argues that multimodal entities can be established as 'semiotic constructs woven by a series of signifying codes that operate simultaneously to produce meaning' (p. 19). Varying 'codes' (modes) are transmitted through both the visual and acoustic channels to create a semiotic construct. Martin et al. (2022) underlines the fact that virtual reality technologies through which the space of the Metaverse is ultimately accessed are 'inherently well suited to systematically study the integration process of multimodal stimuli and analyze the complex interactions that occur [between them]' (p. 2). In other words, users have the ability to integrate received multimodal sensory information they receive so as to construct a unified cognition of the virtual world. From this perspective, multimodal theories can be extended to the concept of the emergent Metaverse. What is more, Martin et al. (2022) maintain that there exists a fundamental difference between virtual reality (VR) and traditional media due to the fact that VR 'introduces additional degrees of freedom, a wider field of view, more sophisticated sound spatialization, or even gives users control of the camera' (p. 1). Additionally, the available VR headsets require immersive engagement and allow for a different kind of active content consumption.

Following the assumption that the use of VR-based technologies imposes multiple stimuli on the user interacting with the virtual environment, the experience of the Metaverse can be situated as an immersivity-driven interplay of sensory feedback encompassing visual, auditory, and haptic stimuli. In discussing the multimodal nature if the Metaverse, it is crucial to point to the so-called embodiment theories are rooted in the idea that 'human cognition and knowing is deeply grounded in multisensory processes and bodily experience of the world, with texts, and with technologies of multimodal inscription' (Mills et al., 2022, p. 2). Taking into consideration the body-based nature of human cognition, VR technologies can be perceived as the next step towards achieving an all-encompassing multimodal perception 'since meaning making becomes immersive, involving motion-sensing technologies and haptic feedback in three-dimensional, virtual environments' (p. 3). Following Mills et al. (2022) and their assumption that VR technologies offer affordances for multimodal communication, in this article it is proposed that the following components ought to be included in the analysis of the 'new multimodal': linguistic (text-based) stimuli, visual, audio, haptic, and kinetic mode related to head and full body movements modes as well as digital artefacts and three-dimensional virtual spaces.

5. NLP-based approach to the Metaverse digital text

In more general terms, Natural Language Processing can be understood as the 'practical field of Computational Linguistics' (Moreno & Redondo, 2016, p. 57). At the same time, Natural Language Processing is conceptualized as the subfield of Computer Science, a branch of Artificial Intelligence (AI) focused on human linguistics and enabling computers to process and interpret human language. Melendez (2022) argues that NLP technologies such as natural-language understanding (NLU) 'supporting all kinds of exchanges in this new extended reality space' will facilitate most of the interactions in the Metaverse. In fact, Metaverse companies like Meta Platforms Inc. are currently developing and launching NLP systems such as Voice SDK that provides the basis for multilingual support in the virtual spaces. With its roots in linguistics, NLP is predominantly responsible for understanding the user intent, extracting keyphrases, converting speech input to text and generating responses based on the input. It is important to point to one of the defining characteristics of the Web 3.0 to which the Metaverse can be attributed; namely, Semantic Web, sometimes perceived as a synonym of Web 3.0.

Semantic Web puts forward the idea of sharing semantic data between computers 'in the form of ontologies which would enable to create a kind of a global database' (Habernal & Konopik, 2013). In fact, NLP and Semantic Web can be regarded as complementary in nature, with NLP employed in order to extract structured data from text-based documents.

Two primary subsets of NLP can be recognized as follows: natural language understanding (NLU) and natural language generation (NLG). While NLU converts human language into a machine-readable format, NLG generates a human language text response. Huynh-The et al. (2022) point to the importance of NLP-based approach in the Metaverse by underlining the way in which NLP offers alternative methods of providing and responding to input. Furthermore, language modeling positioned as one of the crucial tasks in natural language processing 'predicts words or simple linguistic units by capturing syntactic and semantic relations of preceding words and units' (p. 5). As argued by XR Today (2022), while 'navigation in VR takes place through handheld controllers, gestures, or eye-tracking', NLP-based methods would further extend the immersive experience to voice-based controls bringing the Metaverse towards a greater affinity with the physical 'natural' reality whilst 'making it possible to generate audio responses complete with linguistic nuances and voice modulation' (XR Today, 2022). That is why, the Metaverse can be perceived as a space of accelerated interaction between virtual technologies with technologies aimed at processing human language and rooted in linguistics and associated concepts.

6. Computer-mediated virtual environments

In *Computer Mediated Communication: Interaction and Interactivity*, Angle (2006) puts forward the theory that 'another new development that has taken place as a result of computer-mediated communication (CMC), the Internet, and social software is the creation of virtual worlds and virtual communities, in which a person's likeness can be created in or transferred to online social landscapes' (p. 4). The Metaverse as interconnected virtual worlds of social interaction can be seen as a representative of such a new development associated with computer-mediated communication (CMC). Computer-mediated communication (CMC) is hereby used to refer to a variety of systems that fundamentally enable people to communicate with one another by means of networks and computers. December (1996) describes computer-mediated communication 'the process by which people create, exchange, and perceive

information using networked telecommunications systems (or non-networked computers) that facilitate encoding, transmitting, and decoding messages' (December, 1996). Bearing in mind the definition proposed by December (1996), CMC encompasses the online social spaces and virtual environments including its newest iteration – the Metaverse.

As argued by Angle (2006), a modern-day 'virtual world takes the concept of virtual community and places it in an intuitive format, complete with avatars (graphical representation of users), interactive environments, and usually some means of interpersonal and/or small group communication' (p. 4). As stated in the sections above, the Metaverse can be characterized as a persistent social space in which users interact and socialize through embodied digital identities known as avatars. While CMC allows users to engage both in a synchronous (interaction in real-time) and asynchronous (interaction occurs with delayed response) mode. Due to the fact that the Metaverse is grounded in the principle of real-time activity, the mode of computer-mediated communication is synchronous in nature. Importantly, one of the defining features of computer-mediated communication is associated with the richness of interactivity spanning 'text-only interaction [as well as] full audiovisual communication through the use of cameras and microphones' (p. 12).

With that consideration kept in mind, the Metaverse can be seen as a manifestation of computer-mediated communication with an unprecedented degree of interactivity. Indeed, the Metaverse creates new interactive experiences particularly through virtual environment co-creation and shared Metaverse economy based around NFTs seen as a unique type of data (digital assets) stored in blockchain and employed to represent real-life objects such as virtual land. Therefore, one could argue that the Metaverse as an emergent concept based around immersive and interactive technologies can be positioned as a new paradigm for computer-mediated communication enabling innovative forms of engrossing telepresence. Riva and Galimberti (1998) state that 'virtual reality, more than any other technology, carries the detachment of interaction from physical interlocutor co-presence to its logical extreme, and challenges the very concept of interlocutor identity' (p. 1). Following Riva and Galimberti's (1998) assumption that VR transforms the way in which communication is approached, it can be said that networked realities of the current Metaverse have the potential to move beyond the concept of communication proposed within the definition of CMC.

7. Conclusions

All things considered, the Metaverse can be regarded as a highly innovative concept of immersive experience with a great potential to transform the paradigm of reality. The Metaverse conceptualized as the multi-user virtual environment is likely to mark the future of the digital discourse, the beginning of Web 3.0, and the emergence of discourse 3.0 associated with the creation of a decentralized and user-centric concept of Web 3.0. The current stage of digital transformation can be perceived as linked to the transformative idea of Web 3.0. Therefore, the Metaverse can be seen as the next step in the digital transformation occurring in the cyberspace. It can be further argued that virtual environments have been transformed due to the growing engagement of artificial intelligence (AI), immersive technologies including virtual reality (VR), augmented reality (AR), mixed reality (MR), and natural language-based methods in the creation of the shared space of the Metaverse. The following article argues for the consideration of the potential of construing AI-driven systems with a greater degree of interactivity and immersion powered by the introduction of multimodal models that can enable the interaction of multiple modes in the virtual environment.

The three-dimensional reality of the Metaverse is perceived as one of the transformative forces behind the redefinition of communication in the computer-mediated context. Bearing in mind the definition of a digital discourse as the shift towards the user rather than the mere analysis of the medium-specific components, the Metaverse can be positioned as a new type of a digital discourse extended by the virtual reality technologies. Within the scope of this article, Natural Language Processing (NLP) is defined as a subfield of computational linguistics, computer science, and Artificial Intelligence (AI); thereby, the Metaverse is conceptualized as interconnected 3D virtual worlds able to reproduce real-world experiences including human (natural language) with the use of NLP-based methods in the development of the Metaverse.

It can be stated that Metaverse can be seen as a manifestation of computer-mediated communication indicating the need for the extended definition of CMC to account for virtual reality-based interconnected worlds. At its core, computer-mediated communication (CMC) enables people (end-users) to interact and communicate with one another by means of connected networks and computer (electronic) devices. One can argue that networked realities of the current Metaverse have the potential to move beyond

the concept of communication proposed within the definition of CMC. It is crucial to underline at this point that the Metaverse can be perceived as a concept that extends the definition proposed in computer-mediated communication owing to the fact that the Metaverse is built upon interactive and immersive technologies. Thus, the Metaverse can be regarded as a possible new paradigm for computer-mediated communication since novel forms of telepresence and digital identities are introduced by the very concept of the Metaverse as a persistent network of social virtual worlds. Even so, due to the fact that the Metaverse is a dynamically emerging concept, the nature of the Metaverse and its transformative potential ought to be investigated alongside its evolution and newer iterations to be inevitably introduced.

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