Metaverse and the Web 3: a systematic mapping

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Abstract. *The Metaverse and the Web 3 are two emerging technologies whose adoption is growing lately. More enterprises are investing in them to keep up with the market. Therefore, it is important to have a general and better understanding of Metaverse and the Web 3 also known as the decentralized web. This paper describes the relationship between these two technologies through a systematic mapping methodology, aiming to contribute to a clearer understanding of the Metaverse and Web 3.*

1. Introduction

The Metaverse and the Web 3 are two main topics being discussed lately in business and also academy. Their progress has promoted a new age of decentralized movements, initiatives, and concepts [Cao 2022]. Therefore, governments and firms are investing large quantities of money to keep up with the movement. However, there is a lack of consensus when asking about a definition for the technologies or its relationship [Barrera and Shah 2023]. A consensus agreement is clearly needed to guide development.

The objective of this paper is to propose a consensus or characterization for both technologies through a systematic mapping methodology. The first question is: what kind of relationship exists between Metaverse and Web 3? And the second one is: what does the characterization of each one looks like? The answers could provide a clearer introduction to these technologies for professionals and also adopters.

The remainder of this paper is organized as follows. The second section presents the materials and methods used to define the systematic mapping protocol. The third section describes the steps conducted in the execution. The fourth section, in turn, presents the results obtained from the analysis of the selected articles. Finally, the fifth section provides a conclusion and future work for the research.

2. Research Methodology

As mentioned previously, the paper focuses on understanding more about the Metaverse and Web 3 in a general way. Therefore, a systematic mapping has a better approach since it has a broader scope [Klock 2018]. It is also important to mention that the research was conducted using the Parsifal tool - https://parsif.al/.

2.1. Research questions

This paper focuses on 3 research questions. The research questions are shown next:

(RQ1) What are the characteristics of the Web 3?

(RQ2) What are the elements or characteristics of a Metaverse?

(RQ3) What kind of relation exists between Metaverse and Web 3?

2.2. Keywords

A total of 9 keywords are used in the research. They are organized in two groups with an "AND" connector:

Search String = [("metaverse") AND ("web 3.0" OR "3d internet" OR "spatial web" OR "semantic web" OR "web3d" OR "web 3d" OR "web 3" OR "web3")]

These keywords were selected through a trial and error search and a discussion with peers. After the first searches, more keywords were added that had a relationship with Web 3 such as "semantic web" and "spatial web" because in a few papers they were referred in that way.

2.3. Databases

Some of the most used computing research repository are ACM Digital Library, IEEE Xplore, Science Direct, Scopus and SpringerLink [Klock 2018]. Other databases such as Web of Science [Kitchenham 2007] and SciELO (for national scientific journals) [Cataldi 2006] were also included, totaling 7 databases used in the research.

2.4. Screen Selection Criteria

A total of 6 selection criteria were applied during the analysis of article titles and abstracts. An article was included if it was published between 2013 and 2023 (Criterion 1), it provided information about Metaverse or Web 3 (Criterion 2), it contained greater than or equal to 3 (three) content pages (Criterion 3), it was available for reading (Criterion 4), and it was written in English or Portuguese (Criterion 5). In addition, any duplicate article was excluded (Criterion 6).

2.5. Evaluation Criteria

A total of three evaluation criteria were applied during the complete reading of the articles. The following evaluation questions were proposed: How many research questions does the article answer? (Evaluation 1); Was the article published in a conference or in a journal? (Evaluation 2); and What is the journal citation report or impact factor of the publishing vehicle? (Evaluation 3).

According to the question, three different scores were defined: Evaluation (1) for scores of 5.0, 3.0 or 1.0; Evaluation (2) for scores of 2.0, 1.0 or 0.0; and Evaluation (3) for scores of 2.0, 1.0 or 0.0. Therefore an article could get a score between 9 (maximum) and 1 (minimum), where the cutoff score is 4 points.

3. Research Execution

The search provided a total of 278 articles from 7 databases, with 102 duplicates. That means that there is a population of 176 articles by using the search string of "Metaverse and Web 3". Most of the articles come from 4 databases (ACM Digital Library, Science Direct, Springer Link and IEEE Digital Library).

After subtracting the duplicates, all the articles passed through the screen selection criteria to filter them (Section 2.4). As a result, 42 articles passed the criteria and were selected, while 134 were rejected, mainly because they don't provide any information about Metaverse or Web 3.

After selecting the (42) articles, they were fully read and analyzed regarding the evaluation criteria. Considering that the cutoff score is 4 points (Section 2.5), a total of 36 articles passed the evaluation. A list of the 36 selected articles is available at this link: `tinyurl.com/articles-selection`.

4. Results and Discussion

The 36 selected articles have relevant information for the research and their data provide some answers to the research questions. The results and discussion are presented below.

4.1. What are the characteristics of the Web 3?

There are two definitions of Web 3 that need to be clarified and understood. One is known as web 3.0 and refers to the semantic web that was defined by Berners-Lee and refers to an internet where all the data is machine-readable [Park et al. 2022]. And the other definition refers to a decentralized web with no intermediaries where the control and data belongs to the people rather than to big tech companies like Meta, Google and Microsoft [Ferraro et al. 2023]. Then, the correct term that this article and other articles should refer forward is Web 3 or Web3 (when referring to the decentralized web) and not the web 3.0 (semantic web). Therefore, this paper refers to the technology as Web 3.

The Web 3 includes a range of technologies that are often referred to as Web 3 technologies. These Web 3 technologies are: blockchain, smart contracts, dApps (decentralized applications), DeFi (decentralized finance), DAOs (decentralized autonomous organization), tokens, cryptocurrency and NFT (Non-fungible tokens) [Kshetri 2022a]. And all of them share something in common, all work with blockchain technology and smart contracts to support their activities and their decentralization.

"The vision of Web 3 is that humans will reclaim the internet, their data, and their anonymity from large outside forces as corporate firms or government entities" [Kshetri 2022b]. And this Web 3 or next iteration of the internet will be achieved thanks to the Web 3 technologies and a peer-to-peer network [Darwish and Hassanien 2022].

At the moment, all that decentralization of the internet through Web 3 is still in a romantic stage. In fact, the internet is still under control of big tech companies and there is still not a whole adoption of decentralized technologies (because most people still do not know how those technologies work and can not completely trust them yet). There have been fraud activities and hack attacks to blockchain enterprises too. Also, it is important to remark that "inherently decentralized systems do not inevitably lead to decentralized markets or more evenly distributed power" [Park et al. 2022]. In conclusion, there are still many problems to solve for achieving that view of the Web 3 as a decentralized internet free of intermediaries and big institutions monetizing with personal data.

4.2. What are the characteristics of the Metaverse?

There are multiple definitions about the metaverse depending on who speaks and what they want the metaverse to be like. However, the metaverse can be described as a combination of 3D shared worlds where all activities can be carried out with the help of different technologies services [Dwivedi and Hughes 2022].

Since 1992 (date of publishing of the novel Snow Crash) [Guan et al. 2022], the word Metaverse has evolved to include other terms in its definition. The main reason

is because technology constantly change and its applications change too (they often increase). According to [Barrera and Shah 2023], the metaverse definition has evolved in three ways: (i) it expanded its perspective (from a single-world perspective to a perspective of interconnected worlds), (ii) it incorporated more technologies like Extended Reality technologies (VR, AR and MR) instead of only focusing on VR technology and (iii) it also incorporated terms like immersiveness and social interaction. And it will keep changing with the evolution of future technologies and the needs of society too (social needs). It could be described as an empty container [Floridi 2022] for all existing and new technologies.

Until the moment of the research, the Metaverse is characterized by the next technologies: 5G/6G/Wi-fi (for infrastructure), blockchain/AI/edge computing (for decentralization), Extended reality (for space simulation), smart glasses/head mounted devices (for immersion) [Darwish and Hassanien 2022], cryptocurrency/NFT (for economy), digital twins (for mirroring the real world), avatars (for exploring) and more such as IoT/Robotics/Others.

As previously mentioned, the Metaverse is seen as the best container for all the new generation technologies. But technologies are not the only ones that define the Metaverse, there are certain characteristics besides technologies. For example: the Metaverse should provide "interoperability for traveling between Metaverse worlds, transcendence for connecting the real world and the online world" [Choi et al. 2022], "content creation freedom for users" [Nwakanma et al. 2022], "immersion" for user experience and "interaction" for socialization between users [Wu et al. 2022].

The interaction seems to be one important characteristic of the Metaverse because people are social creatures and there is a constant need for using technologies to interact and socialize [Zallio and Clarkson 2022] (e.g. social media, date apps, video games, video applications, etc.). "This kind of social presence is an important way to connect with those one cannot be physically present with. It can increase engagement of those who are on the platform, and aims to facilitate channels with friends." [Zallio and Clarkson 2022]. Therefore, it is clear that the Metaverse will play an important role in society.

4.3. What kind of relation exists between Metaverse and Web 3?

There are two kinds of relationships between the Metaverse and Web 3: one that refers to the Metaverse as the next Web 3 or the next iteration of the internet; and another one that refers to Web 3 technologies as the base to further develop the Metaverse.

Articles often refer to the Metaverse as the next iteration of the internet. According to [Rostami and Maier 2022], "the Metaverse will be about being inside the Internet rather than simply looking at it from a phone or computer screen". Others agree and say that "it will be the future form of internet, linked with Web3" [Mourtzis and Panopoulos 2022] or that "it as an interoperable spatial internet" or "a successor to the internet that is, as Web 3" [Golf-Papez et al. 2022] or "the distant evolution of Web3" [Barrera and Shah 2023]. In essence, Metaverse is often linked with the internet and subsequently with the Web 3. The relationship that they maintain means that Metaverse will surpass or absorb Web 3 to become the future internet. This can be considered a "romantic" relationship, because as previously referred there is still not a whole adoption of decentralized technologies or a decentralized internet yet 4.1).

On the other side, articles also refer to Web 3 as a technology that will further develop the Metaverse. According to [Zallio and Clarkson 2022], "metaverse is based on the principle of decentralization and will very likely run on the Web 3, described as a decentralized and democratized Internet". Others say that "the Metaverse's virtual economy is backed by the Web3 ecosystem, which is comprised of Blockchain technology, smart contracts, and NFTs" [Guan et al. 2022] or that "Web 3 is part of a building block for the metaverse" [Darwish and Hassanien 2022]. To sum up, Web 3 will further help to develop the Metaverse through the use of blockchain and decentralized technologies. This is possibly the most accurate relationship between Web 3 and Metaverse (one technology complementing the other one).

However, there are still few Metaverse platforms that are decentralized. Articles often refer to the most popular Metaverse platforms or applications such as Roblox, Fortnite, Minecraft [Gupta et al. 2022], Horizon Workrooms, Animal Crossing, Gather, Zepeto [Choi et al. 2022], Second Life, Decentraland [Guidi and Michienzi 2022], Sandbox and others. But, most of them are still centralized; only few of them like Decentraland and Sandbox are "decentralizing their power and control" for the community or becoming community-owned platforms [Guidi and Michienzi 2022] where users have a vote inside the platforms (through governance tokens or any tokens). Some other Metaverse platforms are not decentralized but still use Web 3 technologies to run their activities specifically for the economic side (crypto and NFTs). This is the case of Axie Infinity, a video game that introduced the term "Play-to-Earn" and whose core it is the interaction between players, the purchase or creation of digital assets (NFTs) and the generation of tokens (cryptocurrency).

5. Conclusion

The systematic mapping methodology shows interesting results regarding the topics Metaverse and Web 3. For next steps, there could be another iteration that includes words such as "virtual worlds, immersion, virtual reality *and* Web 3" for expanding the paper population, because sometimes Metaverse platforms are referred to as virtual worlds or virtual reality worlds too. After the systematic mapping, a possible research path is exploring topics about accessibility and the Metaverse, because the social aspect is very important in this environment and no one should be left behind [Zallio and Clarkson 2022]. In conclusion, results have been interesting and they provide a general view about Metaverse and Web 3 (as it was intended). There is a clear difference between Metaverse and Web 3, but there is also a mutually supportive relationship between them.

References

Barrera, K. G. and Shah, D. (2023). Marketing in the metaverse: Conceptual understanding, framework, and research agenda. *Journal of Business Research*, 155:113420.

Cao, L. (2022). Decentralized ai: Edge intelligence and smart blockchain, metaverse, web3, and desci. *IEEE Intelligent Systems*, 37(3):6–19.

Cataldi, A. (2006). Las rcn van al scielo. *Revista argentina de microbiología*, 38(3):117–118.

Choi, S., Yoon, K., Kim, M., Yoo, J., Lee, B., Song, I., and Woo, J. (2022). Building korean dmz metaverse using a web-based metaverse platform. *Applied Sciences*, 12(15).

Darwish, A. and Hassanien, A. (2022). Fantasy magical life: Opportunities, applications, and challenges in metaverses. *J. Syst. Manag. Sci*, 12(2):411–436.

Dwivedi, Y. K. and Hughes, L. (2022). Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *Int. J. Inf. Manag.*, 66(C).

Ferraro, C. R., Wheeler, M. A., Pallant, J. I., and Wilson, S. (2023). Not so 'trustless' after all: Trust in web3 technology and opportunities for brands. *Business Horizons*.

Floridi, L. (2022). Metaverse: a matter of experience. *Philosophy & Technology*, 35(3):73.

Golf-Papez, M., Heller, J., Hilken, T., Chylinski, M., de Ruyter, K., Keeling, D. I., and Mahr, D. (2022). Embracing falsity through the metaverse: The case of synthetic customer experiences. *Business Horizons*, 65(6):739–749.

Guan, C., Ding, D., and Guo, J. (2022). Web3.0: A review and research agenda. *2022 RIVF Int Conf on Computing and Communication Tech (RIVF)*, pages 653–658.

Guidi, B. and Michienzi, A. (2022). Social games and blockchain: exploring the metaverse of decentraland. *2022 IEEE 42nd International Conference on Distributed Computing Systems Workshops (ICDCSW)*, pages 199–204.

Gupta, Y. P., Chawla, A., Pal, T., Reddy, M. P., and Yadav, D. S. (2022). 3d networking and collaborative environment for online education. In *ICETET-SIP-22*, pages 1–5.

Kitchenham, B. (2007). *Kitchenham, B.: Guidelines for performing Systematic Literature Reviews in software engineering. EBSE Technical Report EBSE-2007-01.*

Klock, A. C. T. (2018). Mapeamentos e revisões sistemáticos da literatura: um guia teórico e prático. *Cadernos de Informática*, 10(1):01–09.

Kshetri, N. (2022a). Policy, ethical, social, and environmental considerations of web3 and the metaverse. *IT Professional*, 24(3):4–8.

Kshetri, N. (2022b). Web 3.0 and the metaverse shaping organizations' brand and product strategies. *IT Professional*, 24(02):11–15.

Mourtzis, D. and Panopoulos, N. (2022). Human centric platforms for personalized value creation in metaverse. *Journal of Manufacturing Systems*, 65:653–659.

Nwakanma, C., Njoku, J., Jo, J.-Y., Lim, C.-H., and Kim, D.-S. (2022). Creativia metaverse platform for exhibition experience. *2022 13th ICTC*, pages pp. 1789–1793.

Park, A., Wilson, M., Robson, K., Demetis, D., and Kietzmann, J. (2022). Interoperability: Our exciting and terrifying web3 future. *Business Horizons*.

Rostami, S. and Maier, M. (2022). The metaverse and beyond: Implementing advanced multiverse realms with smart wearables. *Ieee Access*, 10:110796–110806.

Wu, L., Yu, R., and Su, W. (2022). Design and implementation of a metaverse platform for traditional culture: the chime bells of marquis yi of zeng. *Heritage Science*.

Zallio, M. and Clarkson, P. J. (2022). Designing the metaverse: A study on inclusion, diversity, equity, accessibility and safety for digital immersive environments. *Telematics and Informatics*, 75:101909.