







ORIGINAL

How artificial intelligence will shape the future of metaverse. A qualitative perspective

Cómo la inteligencia artificial configurará el futuro del metaverso. Una perspectiva cualitativa

Idana Beroska Rincon Soto¹  , Nayibe Soraya Sanchez Leon²  

¹Universidad Nacional de Costa Rica, San José, Costa Rica.

²Instituto Tolimense de Formación Técnica Profesional ITFIP, Tolima, Colombia.

Cite as: Rincon Soto IB, Sanchez Leon NS. How artificial intelligence will shape the future of metaverse. A qualitative perspective. Metaverse Bas. App. Res. 2022;1:12. <https://doi.org/10.56294/mr202212>

Submitted: 14-11-2022

Revised: 16-12-2022

Accepted: 28-12-2022

Published: 29-12-2022

Editor: lic. Mabel Cecilia Bonardi 

ABSTRACT

The announcement of Facebook's rebranding to Meta and heavy investments in the metaverse by companies like Microsoft have brought attention to the metaverse as the next major technological advancement. The concept of Metaverse Seoul was recently unveiled, providing a virtual communication ecosystem for municipal administrative fields and specific services for persons with impairments utilizing XR technology. This study uses a qualitative perspective to explore how artificial intelligence (AI) will shape the future of the metaverse. Three methodological approaches were employed to address this research: literature review, historical-logical and phenomenological approach, and synthesis analysis. We have carefully considered how artificial intelligence has affected the development of the metaverse and how it can increase user immersion in virtual reality. The introduction to this book introduced the basic concepts of the metaverse, the techniques of artificial intelligence, and the role of artificial intelligence in the metaverse. After that, there are several important technology areas - including NLP, machine vision, blockchain, networks, deep learning, and neural interface - and a wide range of application areas - including healthcare, manufacturing, smart cities, gaming and DeFi. researched. The analyzed AI-based solutions have shown that AI has enormous potential to reinforce system design, improve built-in services in virtual worlds, and improve the 3D immersive experience. Finally, we examined well-known metaverse projects that included AI to improve service quality and consider the metaverse ecology. We will now list many metaverse-based AI research trajectories.

Keywords: Artificial intelligence; Metaverse; Qualitative research; Immersive Experience.

RESUMEN

El anuncio del cambio de marca de Facebook a Meta y las fuertes inversiones en el metaverso por parte de empresas como Microsoft han llamado la atención sobre el metaverso como el próximo gran avance tecnológico. El concepto de Metaverse Seoul fue presentado recientemente, proporcionando un ecosistema de comunicación virtual para campos administrativos municipales y servicios específicos para personas con discapacidades que utilizan la tecnología XR. Este estudio utiliza una perspectiva cualitativa para explorar cómo la inteligencia artificial (IA) dará forma al futuro del metaverso. Se utilizaron tres enfoques metodológicos para abordar esta investigación: revisión de la literatura, enfoque histórico-lógico y fenomenológico y análisis síntesis. Se ha considerado cuidadosamente cómo la inteligencia artificial ha afectado el desarrollo del metaverso y cómo puede aumentar la inmersión del usuario en la realidad virtual. Además, se exploraron varias áreas de tecnología y aplicaciones, incluyendo soluciones basadas en IA que tienen un enorme potencial para reforzar el diseño del sistema, mejorar los servicios integrados en los mundos virtuales y mejorar la experiencia inmersiva en 3D. Finalmente, se examinaron proyectos de metaverso conocidos que incluyeron IA para mejorar la calidad del servicio y considerar la ecología del metaverso. Se presentan varias trayectorias de investigación en IA basadas en el metaverso.

Palabras clave: Inteligencia artificial; Metaverso; Investigación cualitativa; Experiencia Inmersiva

INTRODUCTION

Since October 2021, when Mark Zuckerberg announced Facebook will be renamed Meta, the idea has stirred up a lot of attention and discussion. Furthermore, large IT companies such as Microsoft have been investing heavily in the metaverse by acquiring properties like Activision Blizzard for \$68,7 billion to expand gaming in the metaverse.⁽¹⁾

Recently, Metaverse Group paid \$2,3 million for a property on the decentralized virtual reality platform - the highest price ever paid for virtual property. Music artist Snoop Dogg also paid \$450,000 for a parcel of land in Sandbox metaverse where he may host virtual events such as music festivals and concerts to give the audience an immersive experience with virtual reality technology.^(2,3)

The metaverse will soon be recognized as the next major technological advancement and is already drawing the attention of social networks, online game developers, internet finance companies, and other technology titans.⁽⁴⁾

A concept named Metaverse Seoul, recently unveiled by the Seoul metropolitan administration, establishes a virtual communication ecosystem for all municipal administrative fields,⁽⁵⁾ including culture,⁽⁶⁾ tourism,⁽⁷⁾ business,⁽⁸⁾ education,⁽⁹⁾ and public service.⁽¹⁰⁾

Metaverse Seoul will provide certain specific services for persons with impairments to enjoy safe and convenient content utilizing extended reality (XR) technology in addition to delivering other business support services and facilities.⁽¹¹⁾

METHODS

This study uses a qualitative perspective to explore how artificial intelligence (AI) will shape the future of the metaverse. Three methodological approaches were employed to address this research: literature review, historical-logical and phenomenological approach, and synthesis analysis.

Literature review: a systematic review of the existing literature on AI and the metaverse was conducted. Academic and scientific journal databases were used, as well as search engines such as Scopus, Web of Science, Pubmed and Google Scholar. Keywords such as "artificial intelligence", "metaverse", "virtual reality", and "future" were used to identify relevant studies. Articles and books that focused on the relationship between AI and the metaverse were included.

Historical-logical and phenomenological approach: the historical-logical approach was used to analyze the historical development of AI and the metaverse, and how these two fields have related over time. This approach considers historical events and evolutionary trends of the metaverse and AI.

On the other hand, the phenomenological approach was used to explore how people experience the interaction between AI and the metaverse. This approach considers the perspective of users and their experience of interacting with AI in the metaverse.

Synthesis analysis: the synthesis analysis was used to synthesize the findings from the literature review, historical-logical approach, and phenomenological approach. This approach allows for the integration of results and the construction of a broader vision of how AI will shape the future of the metaverse. Content analysis techniques were used to extract themes and patterns from the data obtained from the three approaches.

RESULTS AND DISCUSSION

The worldwide metaverse income potential, according to Bloomberg Intelligence's study, will rise from USD 500 billion in 2020 to USD 800 billion in 2024, with the online gaming sector accounting for half of the global revenue.⁽¹²⁾

Surprisingly, video game firms and studios have plans to transform current conventional games into three-dimensional (3D) virtual worlds that connect to social networks and allow for the hosting of other exciting events like live entertainment and media marketing campaigns in addition to gaming.⁽¹³⁾

By the development of virtual activities in the metaverse, as shown in figure 1, the income of virtual reality (VR) gear and in-game advertising rapidly rises.

Although it has been talked about for decades in the context of the development of the Internet and other technologies, the metaverse is not new.

Figure 2 shows a timeline of the development of the metaverse, covering several important primary events such as the invention of the Internet, its first written reference, the creation of the first virtual world of Second Life, and more recent events. metaverse initiatives by big tech companies like Microsoft and Facebook.

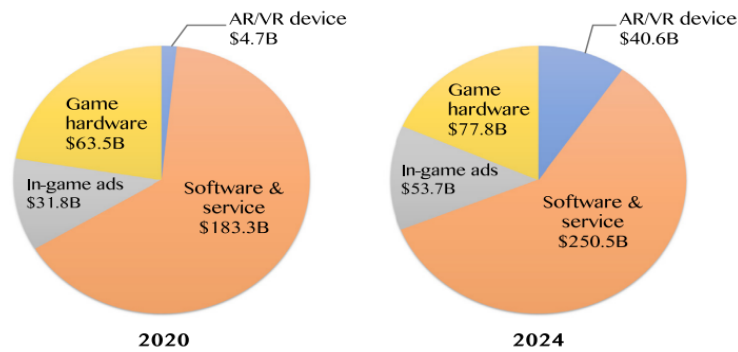


Figure 1. Increase in gaming income helped by 3D virtual worlds

The term "metaverse", coined by combining the words "meta" and "universe", may have originally been used to describe the virtual reality environment known in the dystopian cyberpunk book *Snow Crash* from 1992. The term "metaverse" now refers to a shared virtual 3D environment, or perhaps multiple cross-platform worlds, that can offer consumers a fully immersive experience with interactive and collaborative elements. In addition to virtual places and buildings that persist in the virtual world, many other things can be exchanged and even resemble reality in virtual worlds, including goods, user IDs, and digital products.⁽¹⁴⁾

The metaverse has experienced an unheard-of explosion in recent years, driven primarily by 3D gaming and made possible by advancements in hardware (such as big data storage infrastructure, wireless communication networks, built-in sensors, and graphics processing units—GPU) and software (such as resource allocation in communications, language processing, and computer vision) that make it possible to construct the virtual world more firmly and imaginatively.⁽¹⁵⁾

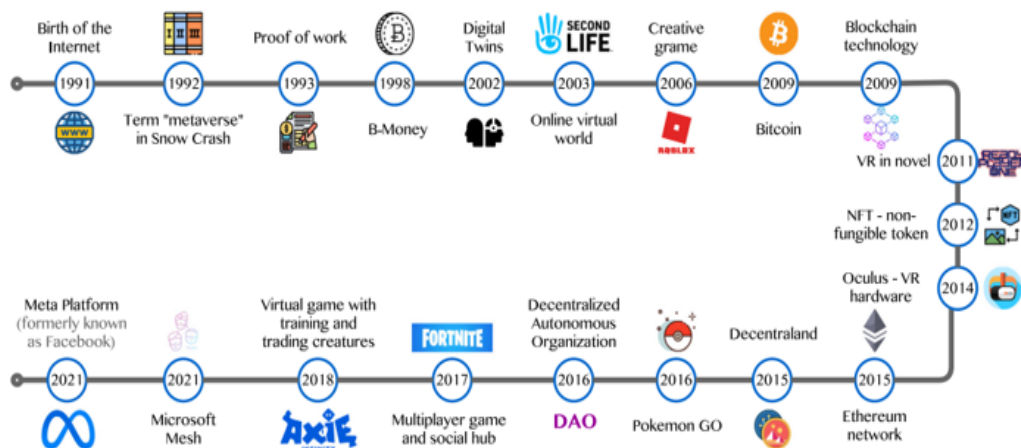


Figure 2. A timeline of the metaverse development involving primary events from 1991 to 2021

By combining artificial intelligence with other technologies such as AR/VR, blockchain and the web, Metaverse can create secure, scalable, and realistic virtual worlds on a stable and always-on platform.⁽¹⁶⁾ The seven-layer Metaverse architecture makes it abundantly clear that artificial intelligence is critical to maintaining infrastructure reliability and improving its current performance. 5G and future 6G systems have implemented many state-of-the-art supervised learning and reinforcement learning algorithms for complex tasks, including efficient spectrum control, automatic resource allocation, channel estimation, traffic decompression, attack prevention and networking. error detection ML and DL learning models combined with sensor-based wearable technology and other human-machine interaction devices can be used to estimate and recognize both simple human movements and complex behavioral patterns.

Therefore, users have full control over how their avatars interact with other objects in the metaverse since their physical movements are translated into their activities in the virtual worlds. These avatars may also communicate via a range of real-world modalities, such as sentiment analysis and speech recognition, which are both assisted by AI in terms of accuracy and processing speed. These modalities include bodily movements, emotions, facial expressions, and physical encounters.

AI is a crucial tool that works in the background to build a beautiful and creative world, providing users with

a seamless virtual-reality experience. Immersive technology like head-mounted displays assist XR/VR in some respects to simulate the look of a metaverse.⁽¹⁷⁾ AI may simplify the content creation process. For instance, certain AI components, such as GANverse3D from NVIDIA, enable designers and content creators to take photos of objects and then transform them into virtual replicas.

Many DL-based rendering methods, such as those for rendering human body parts in 3D, have been presented.⁽¹⁸⁾ These methods feature real-time processing that is accelerated by both software (such as the TensorRT from NVIDIA and the PyTorch3D library from Facebook AI) and hardware, and may attain very amazing accuracy (e.g., GPUs) The Meta-recently-announced AI research supercluster (RSC) is regarded as one of the world's fastest AI supercomputers.

It will hasten AI development and be put to use in creating the metaverse. Moreover, RSC can help AI researchers and scientists construct more robust DL models from huge data sets, such as text, audio, image, and video, for a range of services and applications. To establish the metaverse platform, where AI-driven products will play a big part, all RSC triumphs and outcomes will be used as fabrics.⁽¹⁹⁾

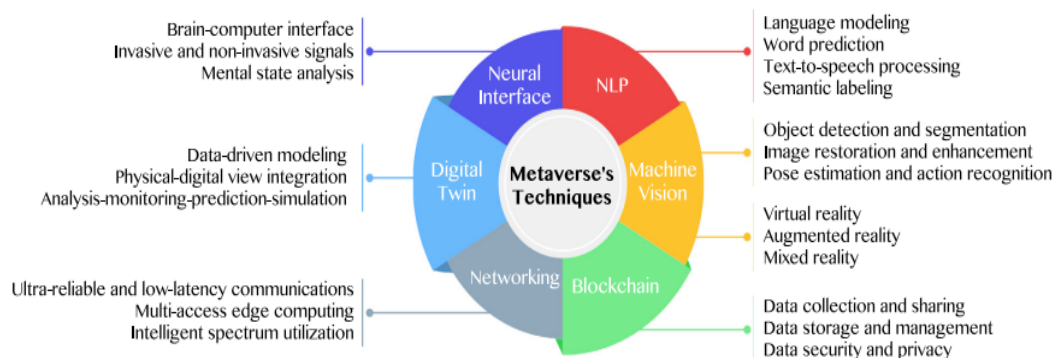


Figure 3. Primary technical aspects in the metaverse, in which AI with ML algorithms and DL architectures is advancing the user experience in the virtual world

Limitations and future prospects

It should be noted that this study is based on a qualitative perspective and, therefore, a comprehensive quantitative analysis has not been performed. Additionally, the literature selection could have been broader and more diverse to obtain a more comprehensive understanding of the topic at hand. Nevertheless, it is hoped that the results of this study will contribute to the understanding of the role of AI in the future of the metaverse.

CONCLUSION

We have carefully considered how artificial intelligence has affected the development of the metaverse and how it can increase user immersion in virtual reality. The introduction to this book introduced the basic concepts of the metaverse, the techniques of artificial intelligence, and the role of artificial intelligence in the metaverse. After that, there are several important technology areas - including NLP, machine vision, blockchain, networks, deep learning, and neural interface - and a wide range of application areas - including healthcare, manufacturing, smart cities, gaming and DeFi. researched.

The analyzed AI-based solutions have shown that AI has enormous potential to reinforce system design, improve built-in services in virtual worlds, and improve the 3D immersive experience. Finally, we examined well-known metaverse projects that included AI to improve service quality and consider the metaverse ecology. We will now list many metaverse-based AI research trajectories.

Conversational AI-powered virtual customer/employee assistants, which are more sophisticated than traditional virtual personal assistants developed for a general purpose with basic dialogue management, can serve a variety of specific purposes of multi-level philosophical conversations to improve user interaction. Machine learning, advanced dialogue management, automatic voice recognition and language processing are just some of the technologies involved in conversational AI processing. These technologies enable human-like communication in the metaverse by recognizing speech and text, understanding intent, translating into different languages, and responding to conversations by voice. User access to discover, own, and modify virtual objects is currently limited in metaverse projects. However, users will soon be able to remix hyper-realistic items like faces, bodies, animals, and buildings to create new experiences with VR and AI. This total immersion in other worlds requires buying AI technology with easy user interfaces. Moreover, it is essential to thoroughly investigate the ethical issues of user-generated metaverse content in terms of its boundaries and regulations for users and external organizations to avoid threats and risks for individuals and society.

REFERENCES

1. Díez JL. Metaverso: Año Uno. La presentación en vídeo sobre Meta de Mark Zuckerberg (octubre 2021) en el contexto de los estudios previos y prospectivos sobre metaversos. *Pensar Public Rev Int Investig Public* 2021;15:299-303. <https://doi.org/10.5209/pepu.79224>.
2. Kshetri N. Web 3.0 and the Metaverse Shaping Organizations' Brand and Product Strategies. *IT Prof* 2022;24:11-5. <https://doi.org/10.1109/MITP.2022.3157206>.
3. Dolata M, Schwabe G. What is the Metaverse and Who Seeks to Define it? Mapping the Site of Social Construction. *J Inf Technol* 2023:02683962231159927. <https://doi.org/10.1177/02683962231159927>.
4. Mourtzis D, Panopoulos N, Angelopoulos J, Wang B, Wang L. Human centric platforms for personalized value creation in metaverse. *J Manuf Syst* 2022;65:653-9. <https://doi.org/10.1016/j.jmsy.2022.11.004>.
5. Huang H, Zhang Q, Li T, Yang Q, Yin Z, Wu J, et al. Economic Systems in Metaverse: Basics, State of the Art, and Challenges 2022. <https://doi.org/10.48550/arXiv.2212.05803>.
6. Zhang X, Yang D, Yow CH, Huang L, Wu X, Huang X, et al. Metaverse for Cultural Heritages. *Electronics* 2022;11:3730. <https://doi.org/10.3390/electronics11223730>.
7. Um T, Kim H, Kim H, Lee J, Koo C, Chung N. Travel Incheon as a Metaverse: Smart Tourism Cities Development Case in Korea. En: Stienmetz JL, Ferrer-Rosell B, Massimo D, editores. *Inf. Commun. Technol. Tour. 2022*, Cham: Springer International Publishing; 2022, p. 226-31. https://doi.org/10.1007/978-3-030-94751-4_20.
8. Seok WH. Analysis of metaverse business model and ecosystem. *Electron Telecommun Trends* 2021;36:81-91. <https://doi.org/10.22648/ETRI.2021.J.360408>.
9. Hwang G-J, Chien S-Y. Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective. *Comput Educ Artif Intell* 2022;3:100082. <https://doi.org/10.1016/j.caeai.2022.100082>.
10. Umar A. Metaverse for Public Welfare and the United Nations Sustainable Development Goals. 2022 Int. Conf. Cloud Comput. Big Data Internet Things 3CBIT, 2022, p. 160-5. <https://doi.org/10.1109/3CBIT57391.2022.00040>.
11. Matthews B, See ZS, Doyle D. XR and creativity: Transformative technologies for good. *Virtual Creat* 2021;11:3-7. https://doi.org/10.1386/vcr_00039_2.
12. Metaverse Market size worth \$ 824.53 Billion, Globally, by 2030 at 39.1% CAGR: Verified Market Research®. BloombergCom 2022.
13. Dionisio JDN, III WGB, Gilbert R. 3D Virtual worlds and the metaverse: Current status and future possibilities. *ACM Comput Surv* 2013;45:34:1-34:38. <https://doi.org/10.1145/2480741.2480751>.
14. Mystakidis S. Metaverse. *Encyclopedia* 2022;2:486-97. <https://doi.org/10.3390/encyclopedia2010031>.
15. Hagerty P. The metaverse pioneers and the colonization of OpenSimulator. *Metaverse Creat New Title Virtual Creat* 2012;2:97-114. https://doi.org/10.1386/mvcr.2.1.97_1.
16. Jaber TA. Security Risks of the Metaverse World. *Int J Interact Mob Technol* 2022;16:4-14. <https://doi.org/10.3991/ijim.v16i13.33187>.
17. Shahbaz Badr A, De Amicis R. An empirical evaluation of enhanced teleportation for navigating large urban immersive virtual environments. *Front Virtual Real* 2023;3:1075811. <https://doi.org/10.3389/frvir.2022.1075811>.
18. Luong NC, Pham Q-V, Huynh-The T, Nguyen V-D, Ng DWK, Chatzinotas S. Edge Computing for Semantic Communication Enabled Metaverse: An Incentive Mechanism Design 2022. <https://doi.org/10.48550/arXiv.2212.06463>.

19. Huynh-The T, Pham Q-V, Pham X-Q, Nguyen TT, Han Z, Kim D-S. Artificial intelligence for the metaverse: A survey. Eng Appl Artif Intell 2023;117:105581. <https://doi.org/10.1016/j.engappai.2022.105581>.

FUNDING

No financing.

CONFLICTS OF INTEREST

None.

AUTHOR CONTRIBUTIONS

Conceptualization: Idana Beroska Rincon Soto, Nayibe Soraya Sanchez Leon.

Investigation: Idana Beroska Rincon Soto, Nayibe Soraya Sanchez Leon.

Methodology: Idana Beroska Rincon Soto, Nayibe Soraya Sanchez Leon.

Writing - original draft: Idana Beroska Rincon Soto, Nayibe Soraya Sanchez Leon.

Writing - review and editing: Idana Beroska Rincon Soto, Nayibe Soraya Sanchez Leon.