The Architecture of the Virtual World

Sugesti Retno Yanti[1]
[1] Fasco Saga Karya, Jl. Jetis Raya, Wedomartani, Kec. Ngemplak, Sleman, Daerah Istimewa Yogyakarta 55584

Article Info

Article history:

Received December 22nd, 2022
Revised June 27th, 2023
Accepted July 5th, 2023

Keywords:

Virtual world
Artificial intelligence
Architecture
Artificial consciousness
Human-computer interface

ABSTRACT

The development of artificial intelligence-based virtual reality technology offers the potential of the digital world as an alternative activity space for humans. The virtual world is expected to complement the shortcomings of the natural world and meet human needs that cannot or are difficult to realize in the real world. The real world is formed by physical matter, while the virtual world comprises bits that cause a considerable difference between the two. This study aims to recognize the positive and negative potential due to differences between the real and virtual worlds concerning architecture. The goal is to answer how quickly the architecture of the virtual world can be put into practical use and dominate human life. The method used is the exploration of libraries and the internet, which are reviewed qualitatively. The results show that the idea of humans still dominates the world of virtual architecture as its creators. However, artificial intelligence can give new ideas beyond what humans think. Therefore, the virtual architectural world gives both positive and negative potential concerning differences in character from the real architectural world.

Corresponding Author:

Sugesti Retno Yanti,
Fasco Saga Karya, Jl. Jetis Raya, Wedomartani, Kec. Ngemplak, Sleman, Daerah Istimewa Yogyakarta 55584
Email: silviagesty@gmail.com

1. INTRODUCTION

The development of digital technology encourages the acceleration of the creation of a virtual world in digital form. The Metaverse is expected to be the technological advancement with the most significant immersive digital experiences in the coming years [1]. The idea or picture of another world as an alternative to the real world in which humans live daily has long existed. Alternate worlds are depicted in various forms, given several names, and often mixed between fantasy, mysticism, and science. In the past, when digital technology had not dominated all sides of human life, the alternate world (or other worlds) was often associated with the spirit world or the spiritual world. In the present, when people are forced to rationalize everything, the presence of virtual reality technology is accepted as a reality. Virtual reality is progressing into a virtual world where people want to be in it with various ideas.

The virtual world is developing at a rapid pace. At least two factors provide positive energy for these developments, namely the readiness of digital technology and the desire of humans not to be bound by time and space. Mark Zuckerberg (Facebook) pioneered the virtual world through a Metaverse brand partnered with Bill Gates (Microsoft). The Metaverse allows one to form an environment to see both real and virtual world spaces. It will enable total cost, number of individuals, and spaces within it [2]. Even though it has the notion of virtual (virtual), the virtual world is still in the form of space and volume. Humans have not been able to imagine a world without space. Thus, the virtual world and the real-world share similarity: space. The presence of such spaces makes architecture relevant to the attribute. Virtual space is defined as a shared simulation space inhabited and shaped by its inhabitants' called avatars. The avatar is our representation in the virtual space experience to interact with objects and other people [3].

The architects still need to get an overdue response to the virtual world phenomenon. Some world architects, such as Zaha Hadid, are even quite active in developing the concept of a virtual world. In addition, young architects also responded positively to the virtual world's development, as seen in the Digital Future forum.
In conventional methods, architects generally make 2-dimensional sketches to visualize ideas in the design process; with these technologies, we can quickly produce visualizations of ideas with stunning visual effects. Visualization will stimulate designers to express ideas with more quality, enrich memory, and multi-directional design. [4]

Architects can use VR headsets and equipment to provide clients or members of their design team with the illusion of being inside a digital space member of their design team with the illusion of being inside digital space that has been designed [5]. Experience in virtual space shows a high level of presence through stereoscopic VR systems with supporting factors such as more advanced interaction methods [6].
The AIA's 2018 survey, The Business of Architecture, noted that 67% of large firms use Virtual reality technology to optimize their design and construction processes [7]. VR's potential in engineering includes prototyping for testing, learning in education, collaboration with coworkers, and designing client presentations [8]. It can streamline costs and time, improve quality, ensure productivity and safety, and expand communication. This article reports on the results of a literature study to reveal the development of the virtual architectural world.

2. RESEARCH METHOD

This article is based on research that explores the latest information from the internet and scientific publications about cyberspace with the help of analysis using Vos Viewer. With the help of Vos Viewer software, we can visually analyze bibliometric information on the development of scientific fields and the latest research performance that has been carried out worldwide. The data explored includes the development of cyberspace technology, the growth of architecture, and the development of brain-computer interface technology. The most referenced journals are those published in 2012. Information related to history is not limited to time.

3. RESULTS AND DISCUSSION

3.1 Publication progress map by keyword

In virtual world architecture, we know with the help of Vos Viewer that there are six research clusters. Most articles were written in 2019-2022. Research related to virtual worlds can be seen in the fact that most research is done on the Metaverse and virtual reality. Research on virtual worlds has yet to be widely researched, as evidenced by the connected network far adrift, so there are still opportunities to discuss the topic.

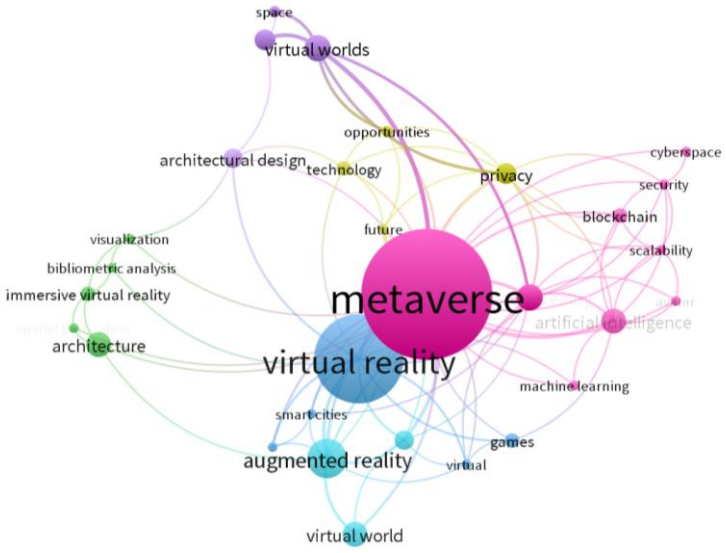

Figure 1. Development map of the topic area of The Architecture of the Virtual World

3.2 Virtual Worlds

The journey of the human desire to explore the new world has been around for a long time. This desire is driven by many things, including finding a better environment, being more comfortable, avoiding disasters, disputes, etc. Thus, man is scattered to all corners of the earth, trying to explore the depths of the oceans to outer space. Human ideas often start from science fiction, which can become scientific facts with the help of technological advances. Nevertheless, the speculative notion of portals to other worlds has long existed in society, whether a fellow physical world of different frequencies or a spiritual one. Digital communication and information technology development produces products that help humans express ideas about other worlds. Worlds based on digital technology are easier to accept. Furthermore, because it is in the form of real, digital technology, it is easier for humans to communicate the ideas of the virtual world and jointly develop them. The definition of Virtual Worlds encompasses many of these possibilities and is flexible enough for future developments while retaining its uniqueness from other technologies [9]. The emergence of the virtual world makes many opportunities open in all fields; economic improvement and education in the entertainment sector will be included in many virtual environments. [10]

According to Margaret Rouse, two types of virtual worlds are entertainment-based and social interaction. In the entertainment category, this virtual world uses in playing games through avatars as their reflection of the real world. This category influenced the genres of fantasy, anime, and movies. In comparison, the social interaction category focuses on interactions carried out by users in the form of education, training, sports experience, experiments, and even politics [11].

Figure 2. Jodie Foster in Contact (1997)

Figure 3. Google Lively (2008)

Figure 4. Johnny Depp in Transcendence (2014)

Google Lively (Lively by Google BETA) is one of the early examples of the virtual world released on July 8, 2008. Google Lively allows 20 people to meet in a virtual space in the form of avatars. They can communicate by text. The appearance of Google Lively was still very rigid according to the technology of that time. This virtual world can be accessed via Internet Explorer and Mozilla Fox with Windows XP or Windows Vista operating systems. Google Lively has technical limitations, and comparisons to the real world, that are portrayed are too much different, so the experience experienced by users is irrelevant. Therefore Google lively was left behind and then officially closed. [12].

Contact (1997) is an example of a science fiction film about another world. The film, starring Jodie Foster, is based on a novel by Carl Sagan (astronomer). The film tells the story of the experience of Dr. Eleanor "Ellie" Arroway, a SETI (Search for Extraterrestrial Intelligence) scientist who found evidence of extraterrestrial life (alien life) and tried to make first contact.

So far, the real world has a nature that is formed without human intervention, whereas the virtual world reflects the idea of humans. So that what exists in the physical world can be as if it is moved or reflected in the virtual world [15]. The virtual world will shape itself as self-contained artificial intelligence is applied. Like real-world systems that process by themselves, humans can also install artificial intelligence and artificial consciousness in virtual-world systems. Its application will make the virtual world system develop independently, not under human control. At that time, in the virtual world, 'natural' elements will grow, as 'initiated' by artificial intelligence. The difference between the real world and the virtual world is thin visually but physically; the virtual world does not require air, water, or oxygen like the real world [16]. In our virtual world, that will control and make the environment even establish relationships and interactions throughout the world that can be arranged at will as desired. While in the real world, everything walks naturally, following nature. The self-contained virtual world system is about to start its evolution. It's like the idea of science fiction. Free Guy illustrates the view of an independent figure in a virtual world (Figure 4). The free guy movie shows examples of visualizations of a blend of the real world and the virtual world wrapped in the fiction genre.

Figure 5. An independent figure depicted in the science fiction comedy film 'Free guy' (2021).

Table 2. Comparison of the Real and Virtual World

	Real World	**Virtual World**
Composition	Real-world material: solid, liquid, gas; organic, non-organic.	Virtual world materials are 3D images composed by the digital algorithm.
Address	World coordinates	Universe coordinate
Obstacles	A particular space is occupied by only one object.	A particular space can hold multiple objects.
Sensors	Five senses.	It is not limited to the five senses.
Occupants	Humans, animals, and plants, according to evolutions.	Creatures are not limited by evolution.
Atmosphere	The earth is covered by an atmosphere with oxygen, hydrogen, nitrogen, solid particles, etc.	The world can be vacuumed or filled with certain gases.
Disasters	Natural disasters (hurricanes, earthquakes, floods, droughts), social disasters, health disasters (pandemic)	Disasters related to energy sustainability (electric) and program (virus).
Biological age	All living beings have a certain lifetime.	No biological age.
Communication among individuals	Direct among human	Represented by avatars
Time	Highly influenced by solar time.	No

From the explanation of the table above, in terms of composition, the real world is denser, consisting of materials that can be felt with the five senses. On the other hand, cyberspace is a form of images that are made into three dimensions. A significant difference is assessed from a user point of view. In the real world,

activities can be felt with the five senses because they are done with the media themselves. In the virtual world, humans are represented as avatars which are images or reflections of themselves physically in the virtual world. In terms of age, time, natural conditions, and disasters in the real world, they occur in real-time and naturally. In the virtual world, everything can be set according to the user's wishes, such as age, avatar shape, and environment.

Along with its development and popularity, virtual worlds (such as Metaverse) create a sense of addiction or dependency for their users. Hence, they (users) are reluctant to leave the virtual simulation. Even those willing to buy completeness in the form of hardware or support must continue to be in that world. [15]

3.2.1 Virtual World Impact

The connection between the real world and the virtual world is inevitable. This connection brings many consequences to all human life, from economics, politics, and law to cultural customs, to the relationship with God. Ethics, privacy, and security are three things that are discussed quite often. These three things have a chain effect on law, politics, and others. Therefore, knowing the impacts, opportunities, and consequences that arise to overcome existing problems is crucial.

Cyberspace is relevant to the future of the internet and the future generation of people. The world loves activities such as communicating with each other, watching movies, having fun, playing games, and gaining a better understanding of the world around us. The virtual world, like a second life, is a space that can imitate and even reflect any aspect of real life. Virtual spaces, such as second life, are formed by user interactions that mark presence, attention, communication, and commitment to other people. It can confuse users because there is no significant difference between the two. [16].

The positive and negative impact of the virtual world has long been studied. In addition to the positive effects that can continue to be explored, attention must be emphasized on the negative impacts that can hit anyone. The virtual world has negative consequences when humans are unaware of the differences between the world and the real world. The rules may be forgotten when one exists in the virtual world. In the virtual world, people can lose context in the real world. A timid person in the real world can be fearless in the virtual world because he feels he is not being watched immediately. It can be as fatal as suicide due to cyberbullying. Therefore, warnings must always be voiced, especially to the younger generation [17].

The virtual world also explores personal life, namely the relationship between adults. Adults tend to be more open and optimistic about the possibility of forming online relationships in the virtual world than in the real world. However, only a tiny part of them managed to build it. Adults are reluctant to use a second life independently. The psychological effects, such as fear, rejection, and intimidation, make people unwilling to use it. [18].

In addition to the positive impacts that can continue to be explored, attention must be emphasized on the adverse effects that can hit anyone. For this reason, legal and ethical arrangements are necessary for every platform. The virtual world's positive potential can trigger a revolution to be more expressive and interact without limits [19].

The virtual world has negative consequences when humans are unaware of the differences between the world and the real world. Rules may be forgotten while in cyberspace due to their infinite nature. In the virtual world, people can lose context in the real world. A timid person in the real world can be brave in the virtual world because he feels he is not being directly watched. This attitude can be fatal such as suicide due to bullying through cyberspace, as well as psychological harm to the person being bullied [29]. Therefore, warnings must always be voiced, especially to the younger generation. Likewise, when avatars perform harmful activities in the size of real-world norms (such as injuring and stealing), [17] security guarantees and privacy protections are needed for their users.

The consequence of the growing virtual world with different content in society raises the risk and the need for vigilance on communication innovation and decision-making so as not to be abused by the capitalist. [20] The year 2040 is expected to culminate in the Metaverse becoming a more subtle and immersive aspect of everyday life and functioning well worldwide [21]. Sensation or experiences such as touching and feeling rough or fine materials and audible sounds in the physical world will be reduced when entering the virtual world [22]. It needs consideration related to the time of use, type of activity, behavior patterns, motivation for service, and age not to cause the risk of switching users from the real world to the virtual world because people are more interested in the virtual world [23]. The consequences of the effect of the tendency to be attracted to the virtual world also reduce relations in the real world.

3.2.2 Potential Virtual World

The business sector must race to invest and be in the virtual world. The virtual world is more helpful for consumers in accessing products and streamlining production time and costs [24]. The virtual world opens opportunities for many new ventures. There are works of creating interior models, avatars, unique objects, and virtual environments, being a content creator, NFT creator, and various sectors such as economy and business, as well as many other job possibilities [25]. In health, virtual reality is used as a therapeutic medium for neurorehabilitation. This therapy involves the interaction with art forms to help the recovery of the patient [26]. In the field of economy and commerce, augmented reality is very helpful in creating a more immersive environment so that consumers can get complete product information. For example, visitors or buyers can be assisted with AR as a product catalog, real product models, to custom requests according to the buyer's wishes. In this way [27], product interest will increase and be profitable from an economic standpoint and practical from a time perspective. In addition to the economy, trade, health, and others, cyberspace has also penetrated spiritual life. In this case, there will be conflict because the teachings carried out dynamically together in places of worship will be added with references to praying in the virtual world. The spiritual experience feels more natural when complemented by light-intensity settings that accentuate architectural elements and symbols to present an emotional experience [28].

The Metaverse is a 3D virtual world network focusing on social relationships through interdependent multilayer networks, the physical world, and the internet [29]. The Metaverse concept consists of cyberspace as a medium to interact widely and openly with various activities. In the virtual world, individuals or groups (even millions of people) can connect and interact without being obstructed by space. A simple device can access The virtual world anywhere and anytime. There is no specific number and criteria requirement for users or participants to enter [30]. All ages can use its unlimited nature for activities such as playing games, education, and medical purposes.

The existence of the Metaverse does not escape the considerable role of Artificial Intelligence (AI) in it, which has great potential to improve three-dimensional immersive experiences and strengthen system infrastructure and develop a virtual world that makes it easier for users [31]. AI also makes the virtual world look very similar to the real world, making the experience obtained more realistic with haptic technology. Such technology creates a sense of touch, vibration, or movement for the user. Furthermore, with the help of the Internet of Things (IoT) [32], the technology is utilized in mapping real-time data from real life to digital reality in the virtual world [16].

Virtual reality plays a role in helping remote learning and education so that creative and exploration abilities become wider [33]. Virtual learning allows the learner to experience better. With the help of avatars, virtual participation may become as effective as the physical world because this learning system is not limited by geographical location. The Metaverse in education is beneficial in terms of accessibility, diversity, equality, and humanity as well as interactive [34]. Although the world of teaching and learning tends to depend on technology, the interaction between a teacher or mentor and a student is physically irreplaceable. In addition, these interactions can be a natural filter for the information obtained by students. Filtering information must be done to assess the validity and relevance of the data obtained by the student [35]. In the world of technology education, this will significantly assist students in gaining complete knowledge, but of course, negative impacts will be caused. Therefore, the need for physical interaction and communication with the teacher can limit how far they (students) will explore.

3.2.3 Virtual Worlds in Architecture

Architecture as a space shaper is closely related to aspects of human life. Even in virtual form, architecture is exposed to the rules of ethics, privacy, and security. These factors can require even more thought than the building technical factors that are decisive in the real world. Wang et al. conducted an in-depth survey on the Metaverse. They focus on fundamental issues, security, privacy, and the current state of the Metaverse and propose anticipating the shape of the Metaverse to minimize negative aspects[36].

Cybernetic architecture is not a new style or the result of a revolution. Developing the human body and knowledge remains at the core of cybernetics. Technology allows people to get into the virtual world. However, actual communication and others are still processed through 'wetware,' i.e., human biological equipment. Even when the brain-computer interface develops further so that humans can enter the virtual world directly from their brains, the biological character of the brain is still the core of communication[37]. The story would be different if, in the future, humans' minds could switch from biological brain platforms to

computer platforms. The human mind is a new entity in the digital world. The virtual world is a world of perception. Thus, the role of neuroscientists and psychologists will be important in shaping the architecture of the virtual world.

The environment of the virtual world inhabited by virtual users (avatars) is formed through a semantic approach. This approach is likened to the shape of the universe in the virtual world [38]. Avatar is a medium of reflection of oneself from the real world, so an avatar can also be called one's identity in the virtual world. The virtual world accommodates activities or activities that take place [24]. Metaverse is also defined as a network of digital technologies that provide immersive and interconnected experiences to create immersive experiences facilitated by hardware technology[2].

The architect's contribution to creating the space of the Metaverse is enormous. But we will see the difference between conventional and meta-architects in making works. Conventional architects will build and realize the physical world, while meta-architects in the virtual world. Meta architects work more closely with game designers to fulfill imaginative design in the Metaverse. In architecture, the Metaverse focuses on the design phase [18]. Architecture mainly uses this tool for construction, focusing on structural systems [39].
In this case, of course, the architect profession needs to respond to the development of these new technologies by exploring forms, structures, and virtual experiences [40]. The opportunities for using virtual technology for the profession of architecture and related fields are enormous and endless [41]. Applying these technologies can produce innovation and time and cost efficiency. Even virtual technology will continue to evolve.

Designing a virtual world in the architectural design process will improve the designers' understanding and communication of 3D space. However, this convenience could be improved because many designers still use conventional design methods [42]. Paper can be replaced by virtual world technology to make the design more efficient [43]. Virtual reality attracts much attention to improve communication in professional work and shared spaces, specifically in BIM education and training [32]. Physical elements of architecture are no longer needed in the virtual world, replaced by virtual objects (holographic) that have the potential to reduce carbon consumption as well [44].

The achievement of a space experience that is made as realistic as possible will positively affect users. Users will feel more about entering a virtual environment[39]. Architectural design in the virtual world is not only in the microsphere, but its application can be utilized in landscape design[45]. The influence of proportions in the virtual world, such as the user's height (avatar) on the building (or objects in it), affects its psychological presence so that it will feel more entered the virtual life. [46]The Metaverse transfers activity within the physical world to the digital environment[47].

4. CONCLUSION

The development of digital technology allows humans to create a virtual world as a companion to the real world. It is a transition period for the dual, real, and virtual worlds. For the architect profession, the development of virtual technology is very appropriate to be applied in the design process and presentation of results. With the help of this technology, architects will explore more, innovate and be able to save time and costs in the process. Gradually conventional architects will be replaced with architects who can develop with virtual technology. In its development in the future, even now that it is running, the virtual world in the field of architects will further explore its forms and features. The virtual world has yet to mature fully, and its positive and negative potential has yet to be estimated. It takes a lot of preparation for people to live in two worlds because the combination brings many new things. For an architect, the challenge of designing within the Metaverse requires a lot of adjustments between the designer and the space user/client because the perceived sense of place will be different between the virtual world and the physical environment. The virtual world is entirely different from the real world, requiring non-technical (cultural, social, psychological, legal, physiological) and technical (software and hardware) readiness.

REFERENCES

[1] R. Moro Visconti, “From Physical Reality to the Internet and the Metaverse: A Multilayer Network Valuation,” *SSRN Electron. J.*, pp. 16–22, 2022, doi: 10.2139/ssrn.4054674.

[2] S. Seidel, N. Berente, J. Nickerson, and G. Yepes, “Designing the Metaverse,” *Proc. 55th Hawaii Int. Conf. Syst. Sci.*, vol. 7, pp. 6699–6708, 2022, doi: 10.24251/hicss.2022.811.

[3] K. Gabriels and C. J. S. De Backer, "Virtual gossip: How gossip regulates moral life in virtual worlds," *Comput. Human Behav.*, vol. 63, pp. 683–693, 2016, doi: 10.1016/j.chb.2016.05.065.
[4] CHIU-SHUI CHAN, "Virtual reality technology in architectural design," *J. Clean Energy Technol.*, no. 6(9), pp. 611–616, 2018.
[5] A. Sankar, "Design Architecture in Virtual Reality," 2019. [Online]. Available: https://uwspace.uwaterloo.ca/bitstream/handle/10012/14751/Sankar_Anisha.pdf?sequence=5
[6] D. Paes, J. Irizarry, M. Billinghurst, and D. Pujoni, "Investigating the relationship between three-dimensional perception and presence in virtual reality-reconstructed architecture," *Appl. Ergon.*, vol. 109, no. January, p. 103953, 2023, doi: 10.1016/j.apergo.2022.103953.
[7] M. Murphy, "How Virtual Reality Is Changing the Architecture Industry," *www.adorama.com*, 2022. https://www.adorama.com/alc/virtual-reality-architecture/ (accessed Jun. 23, 2023).
[8] P. Ace, "VR in Engineering: Amazing Uses and Profitability," *program-ace.com*, 2022. https://program-ace.com/blog/vr-in-engineering/ (accessed Jun. 23, 2023).
[9] C. Girvan, "What is a virtual world? Definition and classification," *Educ. Technol. Res. Dev.*, vol. 66, no. 5, pp. 1087–1100, 2018, doi: 10.1007/s11423-018-9577-y.
[10] Y. K. Dwivedi *et al.*, "Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy," *Int. J. Inf. Manage.*, vol. 66, 2022, doi: 10.1016/j.ijinfomgt.2022.102542.
[11] M. Rouse, "Virtual World," *technopedia*, 2011. https://www.techopedia.com/definition/25604/virtual-world (accessed Jun. 26, 2023).
[12] I. Huvila, "'We've got a better situation': The life and afterlife of virtual communities in google lively," *J. Doc.*, vol. 71, no. 3, pp. 526–549, 2015, doi: 10.1108/JD-09-2013-0116.
[13] F. Bayraktar and H. Amca, "Interrelations between virtual-world and real-world activities: Comparison of genders, age groups, and pathological and nonpathological internet users," *Cyberpsychology, Behav. Soc. Netw.*, vol. 15, no. 5, pp. 263–269, 2012, doi: 10.1089/cyber.2011.0337.
[14] W. Wang, "Difference between the Real World and Virtual World," p. 35, 2020, doi: 10.3390/proceedings2020047035.
[15] U. V Ramesh, A. Harini, D. Gowri, K. V. Durga, P. Druvitha, and K. Siva Kumar, "Metaverse: Future of the Internet," *Int. J. Res. Publ. Rev. J. homepage www.ijrpr.com*, vol. 3, no. 2, pp. 93–97, 2022, [Online]. Available: www.ijrpr.com
[16] K. Li *et al.*, "When Internet of Things meets Metaverse: Convergence of Physical and Cyber Worlds," pp. 1–20, 2022, [Online]. Available: http://arxiv.org/abs/2208.13501
[17] R. I.I., M. U.A., B. G.N., S. D.I., and S. U.H., "Positive And Negative Aspects Of The Psychological Impact Of The Virtual World," *Am. J. Soc. Sci. Educ. Innov.*, vol. 03, no. 05, pp. 25–29, 2021, doi: 10.37547/tajssei/volume03issue05-05.
[18] C. J. O'Brien, J. L. Smith, and D. E. Beck, "Real relationships in a virtual world: Social engagement among older adults in Second Life," *Gerontechnology*, vol. 15, no. 3, pp. 171–179, 2016, doi: 10.4017/gt.2016.15.3.006.00.
[19] C. B. Fernandez and P. Hui, "Life, the Metaverse and Everything: An Overview of Privacy, Ethics, and Governance in Metaverse," 2022, [Online]. Available: http://arxiv.org/abs/2204.01480
[20] Y. Hu and C. Liu, "The 'metaverse society': Beyond the discourse intrinsic potential and transformative impact," *Metaverse*, vol. 3, no. 2, p. 14, 2022, doi: 10.54517/met.v3i2.2128.
[21] J. Anderson and L. Rainie, "The Metaverse in 2040," *Pew Res. Cent.*, 2022, [Online]. Available: www.pewresearch.org
[22] A. Fischer, "Architecture as art in metaverse Anna Fischer Zurich 27-03-2022 Executive Master in Art Market Studies, University of Zurich," 2022.
[23] P. ; B. K. Nagy, "I Create Therefore I Virtually Exist': Digital Content Creation, Virtual Consumption, and Motivation in Second Life," *Virtual world Res.*, vol. 9, 2016, [Online]. Available: http://jvwresearch.org
[24] H. L. S and M. K. K, "a Study on Virtual World of Metaverse," no. 05, pp. 4535–4538, 2022.
[25] JP Morgan, "Opportunities in the metaverse," *JP Morgan*, pp. 1–16, 2022, [Online]. Available: https://www.jpmorgan.com/content/dam/jpm/treasury-services/documents/opportunities-in-the-metaverse.pdf
[26] A. Aldridge and C. L. Bethel, "A systematic review of the use of art in virtual reality," *Electron.*, vol.

10, no. 18, 2021, doi: 10.3390/electronics10182314.
[27] R. M. Kosanke, "済無No Title No Title No Title," vol. 2020, pp. 423–436, 2019.
[28] N. Mansour, "The Holy Light of Cyberspace: Spiritual Experience in a Virtual Church," *Religions*, vol. 13, no. 2, 2022, doi: 10.3390/rel13020121.
[29] I. N. The, M. Strange, and A. M. Analysis, "HYPER-REALITY: BLURRING DEMARCATION BETWEEN SCIENTIFIC REALITY AND FICTION IN THE MOVIE 'DR. STRANGE'; A MULTIMODAL ANALYSIS," vol. 6, no. 2, pp. 48–52, 2022.
[30] J. Keller and M. Laurent, "Divereal: A social virtual world without rooms," *Annu. Work. Netw. Syst. Support Games*, pp. 46–48, 2017, doi: 10.1109/NetGames.2017.7991538.
[31] T. Huynh-The, Q.-V. Pham, X.-Q. Pham, T. T. Nguyen, Z. Han, and D.-S. Kim, "Artificial Intelligence for the Metaverse: A Survey," pp. 1–24, 2022, [Online]. Available: http://arxiv.org/abs/2202.10336
[32] A. Khurana, B. P. Lohani, and V. Bibhu, "AI Frame-Worked Virtual World Application - The Ramification of Virtual World on Real World," *2019 Int. Conf. Autom. Comput. Technol. Manag. ICACTM 2019*, pp. 582–585, 2019, doi: 10.1109/ICACTM.2019.8776724.
[33] C. Rodrigues, C. R. Wigham, A. L. Foucher, and T. Chanier, "Architectural design and language learning in second life," *Virtual Worlds Online Learn. Cases Appl.*, pp. 139–153, 2015.
[34] S. Mystakidis, "Metaverse," *Encyclopedia*, vol. 2, no. 1, pp. 486–497, 2022, doi: 10.3390/encyclopedia2010031.
[35] D. Kamińska *et al.*, "Virtual reality and its applications in education: Survey," *Inf.*, vol. 10, no. 10, pp. 1–20, 2019, doi: 10.3390/info10100318.
[36] Y. Wang *et al.*, "A Survey on Metaverse: Fundamentals, Security, and Privacy," *IEEE Commun. Surv. Tutorials*, pp. 1–32, 2022, doi: 10.1109/COMST.2022.3202047.
[37] D. Zolotareva, Z. H. Architects, and R. Tadauchi, "ZHVR Group Cybernetic Architecture Manifesto Aleksandra Mnich-Spraiter Zaha Hadid Architects," no. March, 2022, doi: 10.13140/RG.2.2.10698.85441.
[38] M. Messaoud, F. Cherif, C. Sanza, and V. Gaildrat, "An Ontology for Semantic Modelling of Virtual World," *Int. J. Artif. Intell. Appl.*, vol. 6, no. 1, pp. 65–74, 2015, doi: 10.5121/ijaia.2015.6105.
[39] S. Shakeri and M. A. Ornek, "How metaverse evolves the architectural design," no. October, 2022.
[40] K. H. Lau and M. Lou Maher, "Architectural Design and Virtual," *Computing*, vol. 18, pp. 4–6, 1999, [Online]. Available: http://www.arch.usyd.edu.au/kcdc/understanding_vds.
[41] E. Ashgan, N. Moubarki, M. Saif, and A. M. El-Shorbagy, "Virtual Reality in Architecture," *Civ. Eng. Archit.*, vol. 11, no. 1, pp. 498–506, 2023, doi: 10.13189/cea.2023.110138.
[42] M. Russo, "AR in the architecture domain: State of the art," *Appl. Sci.*, vol. 11, no. 15, 2021, doi: 10.3390/app11156800.
[43] D. Mateus *et al.*, "From Τέκτων to Τέχνη: Going Back to the Classical Roots of Architecture using Virtual Reality," *eCAADe*, vol. 1, pp. 107–116, 2015, [Online]. Available: http://papers.cumincad.org/cgi-bin/works/Show?_id=ecaade2015_181
[44] S. Kai Tang and J. Hou, "DESIGNING A FRAMEWORK FOR METAVERSE ARCHITECTURE A preliminary framework for mixing holographic and physical architectural elements," vol. 2, pp. 445–454, 2022.
[45] M. Wang, "Research on Urban Architecture Landscape Design Based on Virtual Reality Technology," *J. Phys. Conf. Ser.*, vol. 1904, no. 1, 2021, doi: 10.1088/1742-6596/1904/1/012013.
[46] R. Epplée and E. Langbehn, "Overlapping Architecture: Implementation of Impossible Spaces in Virtual Reality Games," pp. 37–46, 2021, [Online]. Available: https://opus.bibliothek.uni-wuerzburg.de/frontdoor/index/index/docId/24604
[47] P. Faraboschi, E. Frachtenberg, P. Laplante, D. Milojicic, and R. Saracco, "Virtual Worlds (Metaverse): From Skepticism, to Fear, to Immersive Opportunities," *Computer (Long. Beach. Calif).*, vol. 55, no. 10, pp. 100–106, 2022, doi: 10.1109/mc.2022.3192702.

BIOGRAPHIES OF AUTHORS

Sugesti Retno Yanti	The author completed his postgraduate education in the master's Program in Architecture, Atma Jaya University, Yogyakarta. Currently the author serves as an architect at Fasco Saga Karya.