

**AN INTROSPECTION ON THE UPCOMING INTERNET ITERATION,
THE METAVERSE: A SURVEY**

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Abstract: Metaverse, the internet's next iteration, is the network of immersive three-dimensional virtual worlds. The technologies of virtual reality (VR) and augmented reality (AR) have facilitated its development. The metaverse technology, though, is not particularly recent, but recently got more attention due to the advent of Web3. Web3 is decentralized internet. It started as a kind of social media its scope has now widely increased. The purpose of this work is to systematically analyse the metaverse and the changes in its application over time, from its origin to the present. We performed a systematic literature review of empirical studies on metaverse published in the last decade. After looking into this work, we discovered that the metaverse has several other uses outside its potential as a brand-new social media platform, and can this futuristic technology may continue to be a part of various future challenges and research.

Keywords: Metaverse, Artificial Intelligence, Machine Learning, Deep Learning,

1 Introduction

Since Mark Zuckerberg declared Facebook's rebranding as Meta introducing the metaverse as an embodied internet [Chayka, 21] in October 2021 [Kraus, 22], the splendid thought behind the new name has acquired a ton of consideration via virtual entertainment and started a ton of discussion in various regions, including scholastics and business [Kim, 21]. Notwithstanding Meta, a few significant IT partnerships are putting resources into and fostering the metaverse. For instance, Microsoft as of late paid \$68.7 billion to secure the computer game-holding organization Activision Blizzard as a component of consent to grow gaming into the metaverse [Huynh-The, 22]. A plot of property on the Decentraland [Gadekallu, 22] decentralized computer-generated experience stage was as of late bought by Metaverse Group, a firm that

puts resources into metaverse land, for the surprising amount of \$2.43 million, which is the most exorbitant cost at any point paid for virtual land. Snoop Dogg, a notable rapper, acquired a package of land in the Sandbox metaverse [Hissong, 21], where he might have virtual occasions like live performances and shows to give members in the virtual world a completely vivid encounter utilizing computer-generated reality innovation.

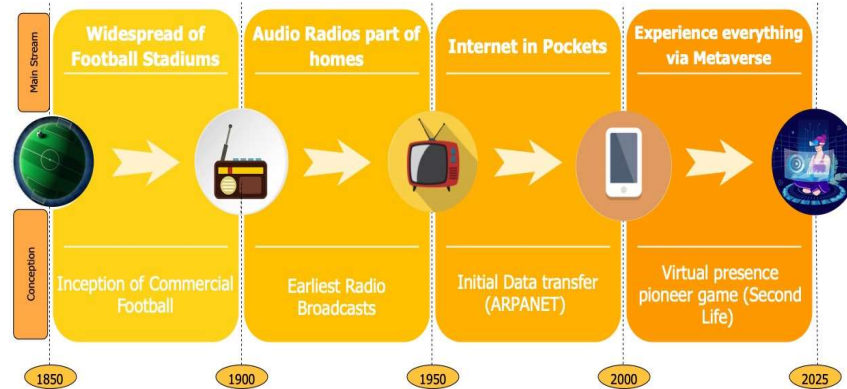


Figure 1: Timeline of the birth of metaverse

The metaverse, which will before long be perceived as the following major mechanical progression, is as of now drawing the consideration of significant informal communities, web-based game designers, and web monetary organizations. Allam et al., [Allam, 22] stated that the Seoul metropolitan oversee, as of late, reported an arrangement called Metaverse Seoul that makes a virtual correspondence biological system for all civil regulatory regions, like culture and the travel industry monetary, instructive, and municipal help. Other than giving different business support administrations and offices, the Metaverse Seoul will offer a few specific administrations for individuals with handicaps to enjoy security and comfort content utilizing broadened reality (XR) innovation. In light of the examination of Bloomberg Intelligence, the global metaverse revenue opportunity will increase from USD 500 billion in 2020 to USD 800 billion in 2024, with the online gaming sector accounting for half of the global revenue. Surprisingly, computer game organizations and studios have a few intend to redesign existing conventional games to three-layered (3D) virtual worlds convolving informal communities [Jian, 22], in which a few alluring exercises, for example, live diversion and media promoting occasions, can hold other than a game. As explained by Bale et al., [Bale, 22] the idea of the metaverse is not new on the grounds that it has been examined for a really long time as the Internet and different innovations have progressed. The course of events of the metaverse's improvement is portrayed in Fig. 3 and described in Table 2, and it incorporates various significant essential occasions [Park, 22], including the development of the Internet, its most memorable scholarly inference, the making of Second Life [Ludlow, 07], and later metaverse drives from significant innovation firms like Microsoft and Facebook [Ball, 22]. The expression Metaverse, which was made by melding the words "meta" and "universe", may have been utilized without precedent for 1992 to depict the computer-generated simulation setting known as the lattice in the tragic cyberpunk novel Snow Crash [Stephenson, 92]. William Burns III defines Metaverse as a collective virtual space [Burns, 17].

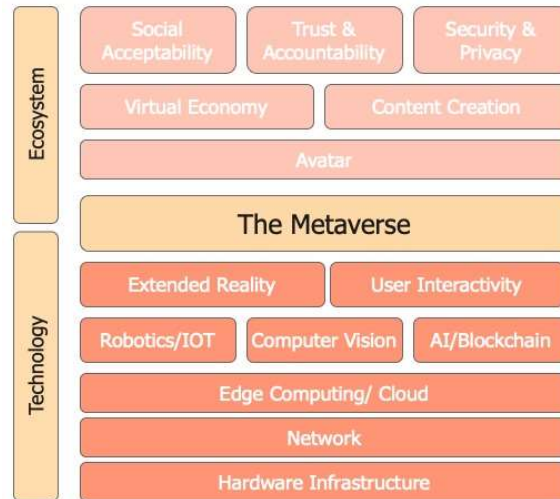


Figure 2: Seven layers of the Metaverse platform

1.1 Our Contribution

This paper makes an effort to recognize the metaverse's development as a futuristic technology and the changes it underwent from its inception to the present. The Metaverse has gained much appreciation in the past years and has made a breakthrough after Facebook committed itself to developing it. It was only a speculative concept before, but as we advance through time it is taking shape as the next iteration of the internet as a network of 3D virtual worlds with an emphasis on social connection. We collected more than 140 research papers to evaluate the work that has been done towards the development of the Metaverse and tried to place everything together to cover each and every aspect related to the it. We also try to shed light on several advanced topics such as Web3, blockchain, NFTs, Avatars, Extended Reality and Decentralized finance and provide a simpler overview for each one. The concerns and criticism have also been highlighted related to the virtual world by describing challenges in various areas. Metaverse has become a hot-spot for marketing and the gaming world, we try to expound such areas as well.

The next part provides a quick summary of those that follow.

- This paper provides a brief historical overview of the Metaverse and discusses its development.
- This paper examines the technological foundations upon which the metaverse technology is built.
- The work outlines the major causes of the massive investment in the metaverse as well as the current market trends.
- The paper outlines the open challenges in the mass adoption of metaverse technology along with future research directions.

1.2 Paper Organization

The paper is organized as follows. The history of the Metaverse's development and its supporting technologies is presented in Section 2. The technological foundation and the evolution of the metaverse has been briefed in this section, it also emphasizes on the simulation and Scenic Object Recognition. Section 3 lists the many Metaverse applications in various fields, along with their prospective uses. The concept of mind uploading, Metaverse in gaming, Real Estate, Healthcare, and human resources have been outlined. Metaverse is briskly flourishing and will support numerous applications in the possible future such as augmented reality calling, promoting tourism and fitness which are also reviewed in this section. The metaverse technology's current market trends and the causes that have contributed to its development are covered in Section 4, stressing upon key factors driving investment, new advancements, consumer engagement, marketing, decentralisation, and Web 3.0. A study is presented in Section 5 to show the difficulties categorizing them as technical, ethical, infrastructural, and economical and privacy and security related, faced widely while implementing the metaverse. Sect. 6 discusses impending prospects and areas that need more research and Sect. 7 provides the chapter's conclusion. Table 1 illustrates some of the words and their definitions used in the study to help readers understand the context.

Terms	Definition
Augmented Reality	Businesses in the Metaverse use augmented reality to entice customers by allowing them to see the stunning intersection of the real and virtual worlds. Customers utilise digital tools more actively as a consequence, becoming used to new technologies.
Virtual Reality	One of the numerous technologies that the word "metaverse" is intended to include is virtual reality (VR). Virtual, 3D places are called VR metaverses. A VR headset is the most captivating piece of technology that allows users to engage with these environments.
Metaverse	Imagine a virtual world where people may interact, live, work, and shop while still lounging on their couches in the actual world. We refer to this as the Metaverse.
Extended Reality (XR)	Mixed reality (MR), Augmented reality (AR), and Virtual Reality (VR) are all closely related to Extended Reality (XR). In order to create XR, AR and VR must be combined.
Decentraland	A virtual world owned by users to create, trade and explore.
Sandbox metaverse	On the Ethereum blockchain, there is a decentralised NFT gaming metaverse called The Sandbox. The Sandbox enables users without technical knowledge to build, promote, use, and monetise their virtual reality NFTs.
Three-layered (3D) virtual world	Virtual reality is a type of 3D simulation that enables users to interact with a virtual world in a way that resembles reality as it is perceived by their senses.

Snow Crash	The science fiction book Snow Crash was written by American author Neal Stephenson and released in 1992. It includes information on politics, computer science, linguistics, anthropology, cryptography, religion, anthropology, memetics, and history.
Cognitive illusion	A typical thinking mistake or thinking trap is a cognitive illusion.
Avatar	You may seem anyway you want in any setting with a metaverse avatar. You are not limited by the environment, a particular region, or any feature of physicality. You are free to appear however you choose.
Object recognition	The field of artificial intelligence (AI) known as object recognition studies how different objects and entities may be recognised by AI systems.
Scene recognition	In order to get the greatest automated correction possible, AI Scene Detection analyses a picture to identify the scenario or lighting conditions and then applies a preset that has been particularly created for that scene.
NPC	These individuals have distinct personalities, voices, and speech and are present in the game's environment. Users cannot play them though since the creators included them in the game.
Voice recognition	Voice recognition is a technique for having a computer recognise spoken language and convert it into written text. It is also sometimes referred to as speech recognition, automated speech recognition (ASR), or speech-to-text.
Tacotron	Google's end-to-end voice synthesis system
Prosody	Prosody is concerned with aspects of speech other than individual phonetic segments, such as intonation, stress, and rhythm, as well as the characteristics of syllables and other larger speech units.
Artificial Intelligence	Speaking about AI, it is a field of study that focuses on creating intelligent computers capable of carrying out activities that typically need human intelligence. It is the driving force for the metaverse.
Machine Learning	Additionally, smart contracts, distributed ledgers, and other blockchain technologies that support virtual transactions might be automated using machine learning models.
Blockchain	A blockchain is a distributed database or ledger. Data are stored in data structures called blocks and are replicated across every node in the network.

Deep Learning		A larger family of machine learning techniques using artificial neural networks and representation learning includes deep learning.
Convolutional Networks	Neural	In deep learning, convolutional neural networks are a particular kind of artificial neural network that are widely used to analyse visual input.
Non-fungible tokens		Tokens known as NFTs can be used to represent ownership of specific items. They allow us to tokenize things like pieces of art, riches, and even real estate.
Natural Processing	Language	Natural language processing, or NLP, is the process through which a computer software is able to grasp human language in its spoken and written forms (NLP).
Decentralized finance		Decentralized finance offers financial products by using smart contracts on a blockchain, cutting out intermediaries like brokerages, exchanges, and banks.

Table 1: The terms and their definition used in the paper.

2 Background

Metaverse is the latest buzz in the technology sector since Facebook decided to rechristen itself as Meta. Many companies are now investing to develop this new technology. This boom in this technology is also the result of Covid19 pandemic, since it serves as a perfect tool that can keep people close even if they are too far away. The story of the metaverse started when the concept of binocular vision was explained by Sir Charles Wheatstone in 1838. The binocular vision [Jiang, 19] a vision where two eyes an animal face the same direction to perceive their surroundings in a single three-dimensional image.

For next few years the concept of metaverse remained in the fiction as a virtual utopia. The new development happened with the advent of first virtual reality (VR) machine [Stone, 01], the Sansorama. It was the time when people could really perceive a virtual world with their eyes. MIT's Aspen Movie Map and Maze war game were the first of their kind. Table 2 shows the event that led to today's metaverse.

Year	Events
1838	The concept of "binocular vision" was illustrated by researcher Sir Charles Wheatstone.
1935	Pygmalion's Displays, written by American science fiction essayist Stanley Weinbaum, is a book in which the main character explores a fictional universe while wearing a pair of goggles that provide sight, hearing, taste, smell, and touch.
1956	The Sensorama Machine, the primary VR device, was created by Morton Heilig.
1970	The Aspen Film Guide, produced by MIT, allowed users to take a PC-generated tour of the Colorado town of Aspen.

1973	The most well-known virtual world accessible through gaming is Labyrinth War.
1991	Birth of the Internet
1992	The term 'metaverse' was coined
1993	Verification of Work: The phrase and notion were introduced in relation to computer security to stop email spam.
2002	Michael Lamonts openly shared the concept and model of the digital twin, the sophisticated counterpart of a real thing.
2003	The online virtual environment known as Second Life was developed by Philip Rosedale and his team at Linden Lab.
2011	Many young people become familiar with the concept of a computer-generated simulated world because to Ernest Cline's book.
2012	A Non-Fungible Token, or "Clever," refers to an amazing object rather than fungible tokens, which can be used with other things, such digital currencies like Bitcoin.
2015	The year saw the presentation of the main cycle of this computer-generated simulation stage. Through a computation of proof of work, "land" was distributed.
2016	The first game to incorporate a virtual world into our current reality was Pokémon Go.
2017	When beat saber was first released, this multiplayer computer game was a huge success and introduced many people to the feel and look of the metaverse and digital money.
2020	Almost 30 million people watched Travis Scott and Marshmello, two well-known people, play in the video game Fortnite in April.
2020	A multi-metaverse interplanetary setting was used to create this incredibly well-known dapp (decentralised application), where NFT characters connected in a decentralised autonomous association to mine tokens and carry out other tasks.
2021	Facebook promoted the Metaverse by changing the name of its parent company to Meta.
2022	The largest companies in the world have their start in the Metaverse, like Meta, Google, Amazon, Microsoft, NVIDIA, and others.

Table 2: Events that lead to the development of today's metaverse

2.1 The Birth of Internet and the Metaverse

The birth of the internet was one of the major climacterics that changed human lives forever. It is a global network that served as a platform that gave birth to various new technologies and the metaverse is one of them. A decade after the term metaverse was coined, came an online virtual world, the second life. It was first online virtual world [Girvan, 18] that people could access and have a feel of leading a second life. It gave the concepts of avatars [Fribourg, 20] and sims. It provides customization options [Waltemate, 18] to the users, just like a sand pit, users could do whatever they want. They could change their hairstyles, skin colour and even the gender. They were able to lead a new life virtually. They would earn in virtual currencies and they exchange them for the virtual commodities inside the game.

2.2 Evolution of Metaverse from the second life

Second Life severed as the primitive version of what today we understand metaverse is. From a fictional concept, it had now become a reality. The decade saw various games launched on the similar concepts that provided a good feel of virtual worlds to the users. With the advent of blockchain [Jeon, 22], NFTs [Hissong, 21] and the cryptocurrencies [Yuan, 18], the internet became decentralised and so is the metaverse. Then came the year 2021, when Facebook rebranded itself as Meta, a metaverse company. Today world-leading tech companies are building in the metaverse. Figure 3 shows the evolution of the metaverse.



Figure 3: Evolution of Metaverse

2.3 Rendering & Recognition for the Metaverse (Software Modalities)

Metaverse is based on three basic concepts which are the Metaverse, avatar [Davis, 09] [Pakanen, 22] and Extended reality (XR) [Xi, 22] [Braud, 22] [Lee, 21]. The Metaverse alludes to the virtual world wherein the avatar acts. The avatar is the person's changed inner self and turns into the dynamic subject in the Metaverse [Buhalis, 22]. XR is the medium that associates symbols in Metaverse and people in reality. It is closely associated to Mixed Reality (MR) [Speicher, 19] [Rokhsaritalemi, 20], Augmented Reality (AR) [Schmalstieg, 17] and Virtual Reality (VR) [Mystakidis, 22] [Kaplan, 21] [Farshid, 18]. The subjective reality that users experience and the actual reality of the physical place are intertwined through the use of a cognitive illusion [Studt, 21] [Wilkinson, 21] [Lindner, 21]. Cognitive processes can be

classified as either static or dynamic. Dynamic cognition involves sensory balance and bodily movement, whereas the proprioceptive senses are static cognition (such as sight, touch and hearing). Behaviour, attention, and adaptation are significant components of dynamic cognition [Paivio, 91].

Environment cognition and object cognition are the two subcategories of cognition, respectively [Schlemmer, 15] [Gardony, 20]. Particularly in the Metaverse, it is critical to reduce the distortion of detection and recognition. Modifying the kernel's form, the expression, and increasing input are all ways to reduce distortion [Ahn, 18]. Faces, body-related stances, gestures, and gazes are examples of objects of object recognition. Sensing, recording Remote and proximity stimulation are the two different forms of stimulation [Panagiotakopoulos, 22]. There are top-down and bottom-up methods for interpreting inputs [Bowling, 20], respectively. The idea of perception must be distinct from this intuitive sense as well. According to recurrent recognition [Liang, 15], the conscious vs unconscious approach can be distinguished by the presence or absence of a movement variation. There are ways to process information instinctively, behaviourally, consciously, and emotionally [Tyng, 17].

An essential component of the Metaverse is the avatar, which is formed and animated to mimic the activity. Vision-based models estimate human postures, recognise hand motions, and anticipate gaze. To anticipate the gaze, the iris, facial contour, and 3D gaze prediction are used. This item identification method includes the phases of, identifying, and tracking [Dwivedi, 22].

2.4 Recognition of objects and sights

Object recognition is the act of measuring an object's size, shape, position, brightness, and colours while viewing it from a distance [Ghasemi, 22] [Hu, 20]. New methods for scene and object identification [Lee, 22] have also been developed (e.g., modal alignment, cross-modal attention, point cloud, and scene graph). The identification of the current state of the scene as well as its numerous components and combinations is effectively accomplished by scene recognition [Matei, 20]. In sub-graph-based scene graph building, a method for grouping and sharing representations is used to organise item pairs into graphs. Scene graphs [Chang, 21] [Ren, 21] are a useful way to supplement the explainable characteristics that have come to be seen as neural network model constraints. Studies have classified bodies in converging circumstances and predicted human postures behind barriers using generative techniques and scene graphs.

The ability to recognise objects in a situation is essential [Terrace, 12]. Additionally, human-centered scene interpretation and non-contact interaction need to be emphasised (e.g., gaze, gesture, pose) [Bergstrom, 20] [Stergiou, 19] [Müller, 16]. The Empty Room project, which explores novel composition and spatialization techniques in virtual 3D worlds, was presented by Webster et al. [Webster, 17]. The number of calculations grows according to the number of objects when multiple things are detected utilising individual object detection, hence an effort is made to lessen the computational load by applying an abstraction idea. Several research abstract many items into representations for quick object detection and effective training (e.g., world models and MONET) [Ha, 18] [Burgess, 19].

2.5 Recognition of Speech & Synthesis

In order to comprehend the world and communicate with other avatars, speech processing and sound recognition [Brodbeck, 20] are helpful. For engaging with other avatars and teaching NPCs in the Metaverse, the conversation acts as a direct route. It is essential to have technology that can isolate one's own speech from background noise since the Metaverse connection is created in a variety of settings. The loudness of the sound in proportion to distance is another factor. For a realistic environment in the Metaverse, voice recognition technology that adjusts the volume based on distance and takes into consideration the surroundings is necessary [Tandel, 20] [Tymchenko, 20].

In contrast to vision, sound synthesis provides a sense of immersion for the user, yet research in this area is lacking. To establish a sensation of presence in the environment and to heighten immersion, it produces sound in the environment. A crucial tool for conveying each character's characteristics is a voice that is appropriate for them. The prosody that users can utilise to emphasise words or convey doubt is the subject of the voice synthesis system Tacotron [Wang, 17]. Prosody is the variation of the voice signal that is left after variation (such as phonetics and channel effects) has been taken into account. This variation catches meaningful utterances and transfers them using subtractive techniques.

2.6 Scenic Object Generation

The two ways that the environment and items in Metaverse are generated are the methods for mirroring the real world and for inventing a brand-new made-up universe. Replicating well-known landmarks (like museums, the Eiffel Tower), as well as areas that people are familiar with (such their homes and schools), in the actual world is a realistic approach to represent the surroundings. As an alternative, it generates a difficult-to-reach setting (such as Mars or the deep sea) to offer a dreamlike experience. In terms of object creation, people and things are the primary targets. Scenic is a language for scenario description and scene generation [Fremont, 20]. Any desired human shape (such as a famous person or a member of your family) may be created as an avatar or NPC via object creation modules [Dengah, 20]. For a fluid multimodal dialogue, it emphasises face emotions and natural joint movements. On the other hand, it creates lifelike objects that are sufficiently detailed to feel like real-world items. Unrealistic anthropomorphic items, such as talking chairs, and fictitious creatures like unicorns and dragons are another category of object.

2.7 Simulated Intelligence and ML based progression of user experience in Metaverse

By combining AI with other technologies like AR/VR, blockchain [Bowling, 20], and networking, the metaverse may create secure, scalable, and realistic virtual worlds on a stable and always-on platform. The seven-layer metaverse architecture [Chen, 22] makes it abundantly evident that AI is crucial to maintaining infrastructure reliability and improving its existing performance. In the 5G [Kaur, 21] and upcoming 6G [Patil, 22] systems, numerous state-of-the-art supervised learning and reinforcement learning machine learning algorithms have been implemented for a variety of challenging tasks, including efficient spectrum monitoring, automatic resource allocation, channel estimation, traffic off-loading, attack prevention, and network fault detection. When combined with sensor-based wearable technology and other devices for human-machine interaction, learning ML and DL models may be used to evaluate and identify complex actions as well as simple human gestures [Zhang, 22].

Users may therefore fully control how their avatars interact with other things in the metaverse since their bodily movements are translated into their activities in the virtual realms. 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 comprise bodily movements, emotions, facial expressions, and physical encounters.

Although immersive technologies like head-mounted displays help XR/VR [Ming, 22] in some ways to mimic the appearance of a metaverse, AI is a key tool that works in the background to create a beautiful and imaginative environment, giving users a seamless virtual-reality experience. AI may make the process of creating content easier. For instance, some AI modules, like GANverse3D from NVIDIA [Salian, 21], allow developers and content producers to take photographs of items and then turn them into virtual reproductions. Several DL-based rendering methods, such as those for rendering human body parts in 3D, have been presented. 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 extremely amazing accuracy (e.g., GPUs) [Ravi, 20] [Jeong, 22].

3 Application Aspects in the Metaverse

The advanced change continues to bring enormous open opportunities to contemporary organisations with various focuses. The exploration of a web 2 experience for a global audience is a substantial advancement in innovation from the use of static websites. Even yet, Metaverse has brought about the most significant alteration in the chain of online development. The intersection between advanced space and cross breed is the Metaverse. In terms of AR and VR, the Metaverse is a three-layered web-controlled environment (Computer generated Reality). Customers in Metaverse can get together and engage in some random movement available in a virtual world. It resembles a digital, networked environment with computerised objects, NFTs, symbols, and much more. The latest development in Metaverse also promotes the idea that the technology may introduce IoT (Web of Things), artificial intelligence, and holographic symbols to its sector. This section aims to provide a brief overview of the of the Metaverse in the current scenario.

There are certain crucial aspects of Metaverse that require a quick explanation before moving on to the applications phase.

3.a Blockchain

It is common to consider the metaverse to include everything on Earth. Everything has been digitalized, including digital twins [Mohammadi, 20] [Grieves, 17] [Cureton, 21] for real materials and structures, client symbols, broad coverage, fine-grained maps of various locations, and more. As a result, enormous amounts of information are generated. It is impossible to transfer such massive data to integrated cloud servers due to the limited organisational resource. Blockchain techniques are expanding swiftly in the meantime [Wang, 21a]. The information hoarding architecture might use blockchain technology to maintain decentralization and security in the metaverse [Mishra, 22] [Xu, 22a]. A scattered data collection, such as a blockchain, stores data in chunks rather than structured tables. Customers'

custom data is entered into another block, which is then related to earlier blocks. Each block is connected in reverse chronological sequence. Users keep blockchain data locally and use a consensus technique to synchronize it with other blockchain data kept on peer devices. Nodes refer to users in the blockchain. Following chaining, each node keeps a complete record of the data that was placed on the blockchain. Millions of other nodes might be used as references to fix an issue on one node if there is one.

3.b Digital Twins

The Metaverse's focus, Symbol, is analogous to the sophisticated twin and computerised Me of the virtual world in terms of importance. A digital twin is a simulation that predicts behaviour. In the virtual world, advanced twins are used to create real-world professionals who can predict outcomes in advance by simulating scenarios that could occur. The framework, which was initially developed by Broad Hardware, combines information and data addressing settings and cycles of several actual substances to understand operating conditions across a considerable amount of time. It is used to anticipate future events and maintain track of attributes and states during a digital twin's lifespan. It may improve the real world and is used in a variety of contemporary and social challenges. It also brings people together to concentrate primarily on practical execution and commercial procedures. A representation of the inner self in a computerised world that is not quite the same as the genuine self is called "Computerized Me." The advanced twin is distinct from the advanced me in that the advanced twin interprets the genuine self objectively while the advanced me interprets it emotionally. Fig 4 shows a brief overview of the merged and perpetual worlds of digital twins. Advanced twins address present problems and simulate future outcomes in terms of applicability. The digital twin, on the other hand, is a projected version of who one is that is not real.

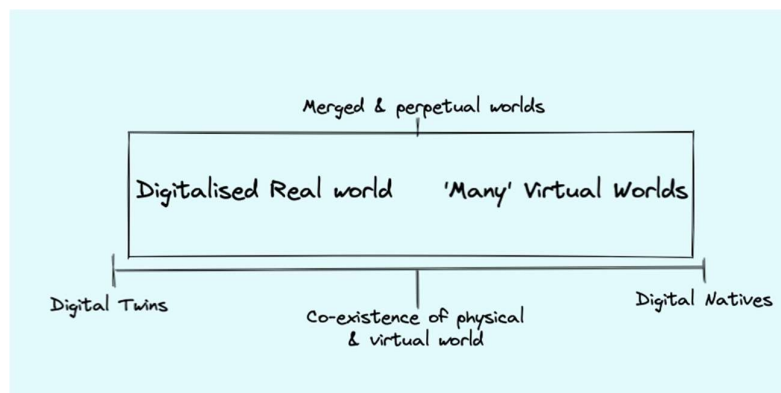


Figure 4: Summarises the merged and perpetual world

3.1 MetaMind

This concept of MetaMind is a process of detaching a person's consciousness from his body, digitizing it, and then uploading the digital consciousness into a machine is known as mind uploading [Choe, 22]. It could include a number of processes, including whole-brain emulation, mind copying, mind transfer, and mind preservation (WBE) [Mercer, 17]. Getting information from the brain, which has more than 125 trillion synapses in the cerebral cortex alone [Al-Malah, 21], is the initial stage in this process. Some claim that in order to completely recreate

the knowledge, the brain would need to be dissected first. However, mind uploading supports a minimally invasive brain surgery that can offer adequate options for duplicating the information in the brain without killing the individual [Manzocco, 19]. Reconstructing the artificial brain is the second stage. According to an approximate calculation presented in *Scientific American*, the brain's memory store capacity might exceed 2.5 petabytes (2,500 TB). Therefore, processing this vast memory should be possible for the artificial brain. The greatest artificial neural network, known as GPT3 [Floridi, 20], is now only 1/300th as powerful as the human brain. The next stage is to relate the awareness to a substrate, such as a metaverse, or a network of interconnected artificial brains. Another choice is Elon Musk's Optimus humanoid robot [ET Spotlight Special, 22], which would function as a person's new physical body. These means would take a ton of time, exertion, and cash from researchers, specialists, and tech organizations making progress toward mind transferring. Regardless of whether it will be a triumph, the reality of the situation will come out at some point.

3.2 Healthcare

The well-being area has of late started using historic advancements like VR and huge information joined with AI in programming and equipment to improve medical services activities, help the viability of clinical gear, and lower the expense of medical services administrations [Sun, 22b] [Davenport, 19]. The metaverse empowers clients to study, fathom, and trade patients' medical problems and clinical information in a vivid manner, from a 2D climate to a 3D virtual world. Using VR/XR frameworks, AI altogether affects numerous aspects of medical services and medication [Vasarainen, 21]. For example, it analyses patients even more actually, makes quicker, more exact clinical choices, works on constant radiology, and supports more viable re-enacted learning conditions for assistants and clinical understudies.

Simulated intelligence has been executed to naturally distinguish muddled examples of tangible contribution to different wearable gadgets for medical care and wellbeing applications and administrations [Singh, 22]. An active work location framework was presented in utilizing the tangible information of a few wearable gadgets to help specialists and wellbeing health experts in making decisions for everyday living help and early solid gamble mindfulness [Yadav, 22]. To build the pace of movement acknowledgment, the method blended internationally high-quality elements with locally profound highlights (i.e., those inferred utilizing a profound CNN). To change inertial tactile signs (like those from an accelerometer, whirligig, and magnetometer) into a variety picture for CNN-based human movement order, an extraordinary encoding approach called Iss2Image was introduced in [Hur, 18].

3.3 Real Estate

We have witnessed a massive investment in virtual land in the metaverse from private investors and foundations. Virtual game environments like the Sandbox and Axie Infinity as well as virtual worlds like Decentral-Land and Upland, where users may buy, sell, and exchange goods, including real estate, have been proactively offered as part of several metaverses (plots of land and virtual houses). These cutting-edge real domains are typically connected by non-fungible tokens (NFTs) [Wang, 21b], are restricted by supply to ensure their qualities over the long haul in light of shortage. The domain in the metaverse can be utilized as a virtual spot for building developments (houses and workplaces) or holding computerized occasions (e.g., workmanship presentation and design show) [Wang, 22a]. Additionally, the metaverse is one

more expense proficient channel for land organizations to show the property to clients prior to pursuing choice at last. With VR-supported vivid experience, the clients can find the property, including inside and outside from definite furnishings and generally speaking design, by means of VR visits and intelligent walkthroughs [Nalbant, 21].

3.4 Electronic Commercialization

As the ongoing flood of modern upheaval, advanced change in assembling has been occurring with computerised association among machines and frameworks to all the more likely dissect and grasp the actual elements. Not quite the same as computerised change to improve the actual world through computerised operations, the metaverse makes a virtual world that is deciphered onto the actual world in light of the groundwork of reality interaction and tirelessness. By cooperatively taking on state-of-the-art advances, like AI, the metaverse for manufacturing can fundamentally modernize computerised activities in the ongoing computerised upheaval [Sun, 22a]. The growth of assembly systems and the dispersion of their locations necessitate the creation of a new distributed, networked, and virtual environment. In these situations, Metaverse plays a crucial role in the development of a large-scale virtual manufacturing [Peruzzini, 21] environment (LSVME) [Lee, 11], which enables more extensive production and incorporates concepts like a collaborative manufacturing environment or networked manufacturing environment. Presently, AI with ML calculations and DL models have extensively added to the assembling space by means of various modern applications [Baduge, 22]. In assembling, shortening item lifecycles and increasing the quantity of item variations are the primary explanation of high cost for incessant creation framework reconfigurations and redesigns, particularly with ML-based frameworks which have invested more energy and processing assets for new information assortment, pre-processing, and model learning.

3.5 Human Resources

These days, numerous large tech organizations are being innovative to look for and speak with youthful abilities who are searching for occupations. The enlistment habits range from dispatching more youthful representatives/pioneers to online meeting candidates with video calls to holding position fairs in the metaverse. Potential candidates can login into the metaverse with blockchain-helped validated record and afterward control their symbols to uninhibitedly talk about with different symbols addressing the organization's human asset chiefs and venture leaders [Yang, 22]. For enlistment direction, the candidates can ask or get help from the menial helper with AI-based NLP. In these sorts of enrolment occasions, the objective is to produce a cordial climate for both the selection representatives and candidates for free-form correspondence, in which the candidates can effectively find more data about work positions all things being equal of inactively being posed inquiries by scouts. Somewhat recently, arising advancements, (for example, 5G, IoT, and DL) have brought laborers/representatives numerous advantageous alternatives (completely remote and half and half disconnected on the web) to customary work; nonetheless, the metaverse will reform the fate of work and the working environment. As of late, Facebook presented Horizon Workrooms [Paul, 21], a very much planned gathering stage that permits clients, addressed as symbols, to work, team up, and speak with others, other than preparing and training exercises, in the virtual space by VR gadgets.

3.6 Gaming

With ML and DL changing and changing the gaming business across various stages, including console, cell phone, and PC stages, gaming has forever been a top application in the metaverse [Faraboschi, 22] [Cheng, 22]. This part will take a gander at how ML and DL can change game creation and how to make the up-and-coming age of gamers in the metaverse. In the beyond a decade, AI has essentially changed how computer games are made [Westera, 20] [Jayaramireddy, 23]. Computer game engineers and studios are progressively going to AI (ML) as a powerful device set that helps frameworks and NPCs to answer player action powerfully and fittingly to produce more practical universes with charming difficulties and unique story [Chan, 22].

Corresponding to an assortment of examination points, including NPC conduct technique and learning, strategic preparation, player reaction displaying, procedural substance creation, player-NPC collaboration configuration, general game AI, AI-helped game narrating [Branch, 21], and AI in business games, the job of fake and computational knowledge in games has been examined. The three viewpoints canvassed in this paper were the work of AI calculations in every subject, the value of AI to human clients across all points, and human-PC collaboration. A broad survey in looked on the use of AI calculations in canny video and PC games for learning and dynamic in-game.

3.7 Smart Existence

Metropolitan arranging has gone through certain years currently dealing with an idea like the metaverse: computerized twins [Lv, 22] [Far, 22]. These virtual duplicates between savvy urban communities permit possible future difficulties to be expected. Its idea owes an extraordinary arrangement to huge information, regarding taking care of and improving the virtual city with however much information as could be expected. Virtual the travel industry that took off during the pandemic has comprised the primary headway of a computerized application [Sarkady, 21]. In any case, there are some more. Virtual conditions will be related to another sort of economy, which will be digitalized, with new open doors, yet new dangers as well.

3.8 Decentralized Occupations, currency, NFTs, Trading (Financial Aspects)- DeFi

In view of an open arrangement of money, decentralized finance (DeFi) [Werner, 21] is a digital currency based financial administration which is consistently customized through brilliant agreements to construct trades other than offering many significant types of assistance, for example, loaning, yield cultivating, and protection with-out concentrated specialists. Not quite the same as unified finance which is controlled or overseen by a concentrated substance or an individual, DeFi, with blockchain innovation, works with monetary administrations from shared and permits clients to completely control their resources while guaranteeing security and protection. DeFi administrations are normally conveyed through decentralized applications (Dapps) [Cai, 18] which are altogether based on publicly released dispersed stages. By coordinating DeFi (counting essential and expert administrations) into the metaverse, clients can make buys virtual items recognized by NFTs [Vidal-Tomás, 22] [Christodoulou, 22] [Brown, 22] in the advanced world, however will get the genuine items in the reality. Moreover, clients can create gains in the metaverse in view of the DeFi environment with the loaning, getting, mining, and marking cryptographic forms of money or different tokens. Clients can furnish liquidity to the liquidity pool with a fundamental AI-based system of a decentralized trade to procure impetuses. Trading tokens (can have a place with similar chain or various chains) is the fundamental help that is focused on to foster first on any Dapps.

3.9 Other Potential Applications

Most people think of the metaverse as merely a cartoon imitation of the actual world, but its growth trajectory indicates otherwise. The world jumped towards virtual reality as soon as Facebook adopted the moniker, Meta. These contributions increased the diversity of this domain. People are purchasing property, playing video games, and constructing houses [Nalbant, 21]. Everyone is utilizing this cutting-edge technology, from video games to the fashion business [Sayem, 22], and completing tasks that would be challenging in the real world.

Metaverse is shedding its reputation as a gaming industry and rebranding itself as a technology that offers 360-degree virtual showrooms, manufacturing, human resources, training, and manufacturing. Its technology includes interactive showrooms, onboarding programs for human resources [Park, 22], safety procedures, and tours of museums [Buhalis, 22]. There is an array of potential applications and with the wide adoption it's been increasing.

3.9.1 Horizon Home

With becoming a metaverse company, Meta announced various applications and tools to make the user experience in the metaverse, more engaging. One such tool is Horizon Home. A similar idea proposed by Tim Gorichanaz [Chanaz, 22] where he says that human existence revolves around housing, hence he suggested that guidelines for moral design in the metaverse be created. Such structures would convey and harmonise societal values, serve as a guide for designers and other stakeholders, and establish a foundation for accountability. Horizon home is a virtual place where individuals may interact, get to know one another, and collaborate without being constrained by the laws of the real world. In the latest addition, it allows users to create and develop their virtual world. They will have the option to construct and personalize their own Horizon houses per their preferences, a feature that may even inspire programmers and creators to support the Metaverse's creative sector. The company is planning to integrate multiple applications that would help us work in our virtual retreat.

3.9.2 Augmented Reality Calling

The Covid Pandemic has changed the way we work, live, and meet. With the advent of social distancing, our lives have gone over video calls. This has helped us to adapt the mobile and desktop screens but still, it is not a perfect solution. With the arrival of the metaverse, there comes a way of future communication- Augmented Reality (AR) calling [Xu, 22b]. It allows communicating as we and the other person are sitting together. It helps to feel the presence of our friends and co-workers. With the help of our smartphones or the latest AR glasses, we can see them as realistic avatars on the ground in front of us.

3.9.3 Fitness

After the impressive progress of metaverse technology in other domains, it has also arrived in the fitness market. The emerging trend of fitness gamification [Zhao, 16] will lead VR gaming [Chan, 17] and fitness to merge. It is a creation of a brand-new type of immersive workout in which all elements of a gym setting, including music, images, wearables, and instructors, come together on a single platform to provide users with an energizing workout. Due to these developments, VR training applications are also being created that will bring the well-known martial arts workout to the metaverse environment in a fun, gamified format. With this new

technology's appeal and potential for significant income creation in the fitness business, people will pay greater attention to their exercises. Additionally, it will increase everyone's access to fitness. The new parallel reality that will rule the globe in the upcoming years is the metaverse. Fitness centres that come to your home will be made possible by virtual but more intimate experiences [Lugrin, 15].

3.9.4 Urban Resource Planning & Management – Tourism perspective

Urban planning can be a tedious job for governments to perform, however, the metaverse has made this task a little easier. Urban planners [Schumacher, 22] have proposed that because metaverse cities have access to methods for rapid input from citizens that are not practical in the creation of physical cities, they can serve as examples of resilience and societal harmony for their physical equivalents. Bibri et al., [Bibri, 22] suggested a conceptual framework meant to serve as a roadmap for developing a model of virtual urbanism. Based on more in-depth qualitative analysis, empirical research, and real-world application, the framework may be expanded it in to something useful. In terms of the climate, geo-engineers and architects are hoping that immersive virtual reality games that simulate the potentially disastrous effects of climate change might inspire group action and stimulate solution-making for the future of cities in the face of the increasing climate catastrophe.

In addition, by utilizing the advantages of virtual tourism [Melo, 22], metaverse tourism would seek to enhance the trip experience of customers. The benefits of metaverse tourism may enable individuals to travel from the comfort of their homes. Buhalis et al., [Buhalis, 23] says that Tourism and tourism-related businesses must deliberately employ the Metaverse to develop hybrid virtual and physical experiences that allow customers to communicate with them as well as with other visitors beforehand, during, and then after their stay. The metaverse has made it possible to compare various services, including lodging and dining options. Users can communicate with hospitality companies thanks to the breadth of metaverse tourism. By using the metaverse to take virtual tours of the hotels or venues, travellers and travel planners may schedule vacations and activities. Consequently, it offers an excellent platform for enhancing the marketing efforts of travel and hospitality firms.

4 Metaverse Trends

It became hard to move ahead without giving heed to the metaverse technology since Facebook decided to change its name to Meta. The idea of a virtual immersive world enchanted many, however, the vision regarding the same varies a lot. Some believes metaverse as a virtual reality environment while others see it as a medium to collaborate remotely on some project. There are people who are advocating for the democratization of the internet [Zarrin, 21] [Schrape, 19] and are in the opinion that the metaverse would play a greater role in realizing this. It is believed that this technology would add billions and trillions to the global economy and this coming decade would be a crucial one in determining the direction this technology takes. Fig 5 shows the global market trends in the metaverse.

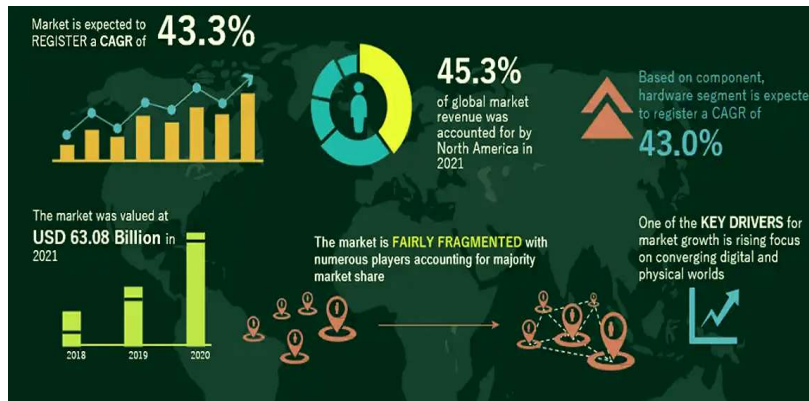


Figure 5: Global market trends in Metaverse

4.1 Key Factors That Are Driving Investment in the Metaverse Technology

The reality of a virtual world, which will enhance online experiences and make human relationships more immersive, continues to encroach on our reality day by day. This brand-new type of virtual world is reportedly now worth billions, and as it becomes more commonplace, its economy will only expand. This world is known as the metaverse; your guess is as good as mine. One of the most well-liked future technologies that have drawn a tonne of investment is the metaverse. Almost twice as much was invested this year as there was the previous year. These investments are driven by several variables. Fig 6 illustrates the justifications for large investments.

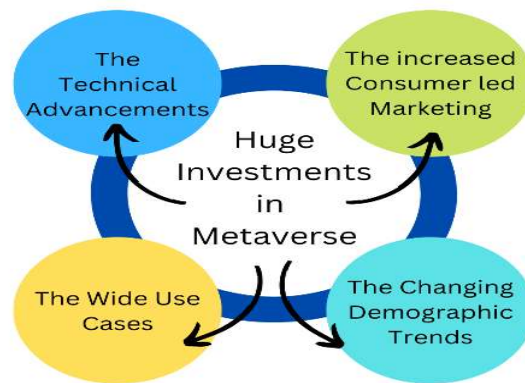


Figure 6: Reasons for Huge Investments in the Metaverse Technology

4.1.1 The New Advancements in the Technical Infrastructure.

Technology is at the vanguard of innovation, and it is influencing the metaverse more and more. Virtual and augmented reality, cloud computing, and the 5G network are anticipated to be the driving forces behind an immersive virtual experience. High-resolution technology and data-hungry devices will have the ideal pathway to operate the metaverse's capabilities thanks to the 5G network. This is closely related to how edge computing has developed. The development of edge computing will make it feasible to rapidly store data by storing it on local

devices, doing away with the need for constant communication with the cloud. Now that the cloud [Jiang, 22] and 5G technologies have been developed, it is feasible to compute with high throughput and low latency. Powering this technology has been made feasible by these significant technological advancements. The open-source apps that make the virtual world possible represent the zenith of technical development. The capacity to bring the metaverse to mobile devices is one of the areas driving investor investment in metaverse development, even if users will rely on AR/VR-powered equipment to completely immerse themselves in the metaverse experience.

4.1.2 The Demographic Contradistinction

The world is changing and so are the people living in it. There is a significant change in the population, family structure, and other social characteristics all around the world. The population that uses internet and goes online is tremendously increasing. People are moving away from their native lands whether to explore the world or in search of better opportunities. These situations demand a technology that can serve their evolving needs and the metaverse fits better in this case. It brings people together [Ilyina, 22] even if they are a continent apart. It also serves as a medium to reach a large population, which physically would not have been possible.

4.1.3 The Increased Consumer Engagement

The day when using customers as a means of profit-making and taking them for granted is long gone. Businesses experimenting with the metaverse may connect with, engage with, and encourage both human and machine customers in order to create new value exchanges, revenue streams, and markets. In recent years, there has been a major increase in consumer-led marketing, which prioritises the requirements of the customer and seeks to enhance the customer's overall connection with the businesses. The metaverse appears to be a better channel for firms to engage their customers by introducing innovations in the virtual world [Dawson, 22]. Based on the decisions that customers make in the metaverse, brands may more accurately tailor experiences. Due to regional restrictions or the size of their marketing and sales teams, brands will be able to use this new channel to connect with customers they were previously unable to reach.

4.1.4 A Broader Range of Usage Scenarios

Facebook's decision to adopt the moniker "Meta" sparked a rush into virtual reality. Video gamers, NFT vendors, construction builders, property buyers, and practical applications that are challenging to undertake in the actual world are just a few of the groups that make up this Web 3 arena, which is getting more diversified in what it offers. A virtual world is thought to be great for the gaming industry, and Metaverse has become a well-known draw for fans of video games. Consumer traction is currently spreading to further regions. Metaverse is now used in immersive retail [Shen, 21], entertainment [Baía Reis, 22], educational experiences [Warburton, 09], and sports [Tayal, 22]. The usage has made its way from virtual showrooms to virtual employee training programs. Metaverse is now even used by governments all around the world to enhance their engagements with citizens. With such broader user scenarios, metaverse is a highly invested tech.

4.2 The Metaverse Applicability in Today's World

Metaverse is a viral topic in the tech industry these days. The idea of a three-dimensional version of the internet is captivating and is attracting users and investors towards it. The immersive experience that the metaverse provides allows has brought an enormous change in the way our industries used to work. Industries have adopted the metaverse as a tool to bring change in their practices, which has led to the birth of multiple trends where the metaverse is excessively used in today's global market. Fig.7 shows the trends where metaverse is used in today's world.

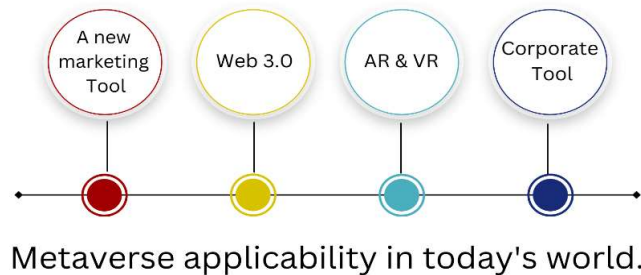


Figure 7: Areas where metaverse is used

4.2.1 Metaverse as a new marketing tool

With the shift from the traditional internet (1.0 & 2.0) to Web 3.0, metaverse technology has emerged as a new marketing channel that helps brands to enhance consumer experience [Han, 22] and engagement. This trend is still at its nascent stage and yet to be fully consolidated, but businesses and brands have already started establishing their metaverse presence. Apparel brands are one of the top players utilizing the power of metaverse to provide a more engaging way to connect with their customers. Metaverse shall provide a virtual emplacement for the industries to experiment with.

4.2.2 Decentralisation and Web 3.0

Decentralization is one of the important visions that we have for the Metaverse. With the advent of web 3.0, this vision has started taking shape [Kshetri, 22]. Blockchain Technologies and Distributed ledgers have given rise to a new form of the internet, which is decentralized. A decentralized internet will no longer be under the control of big corporates and will be owned by the users. The metaverse with decentralized characteristics can be categorized as a Decentralized autonomous organization (DAO) [Wang, 19] which will give rise to a community-owned Eden where the users will have absolute control.

4.2.3 Augmented and Virtual Reality

The metaverse is built on the notion of immersive, experiencing technology. A three-dimensional virtual world that would be more engaging than the current version of the internet. The ideas about the engagement revolve around various immersive technologies- Mixed/extended reality (MR/XR), virtual reality (VR), and augmented reality (AR). The initial

idea of virtual reality brings the notion of a headset device, but this is not the only one. Beyond these devices, full-body haptic suits [Cardenas, 19] are in use at various space organizations. Devices to introduce the notion of smell and taste in the virtual world. Metaverse will realize the vision of virtual reality at the fullest which will be more realistic and immersive.

4.2.4 Metaverse as a Corporate Tool

The metaverse promises to offer platforms, tools, and complete virtual worlds where business may be conducted remotely, effectively, and strategically in addition to its potency as a marketing tool. The idea of a digital twin- a virtual simulation of real-world humans or products can be used to test new ideas in a safe digital environment. The metaverse is being used in the offices for onboarding and training. The collaborative work environments [Orel, 22] that metaverse offers allow distant teams in a company to stay involved in their co-workers' creative processes.

5 Open Issues and Challenges

A new method of interaction, the metaverse aims to blend our physical and digital existence to open a way for an open, interactive, and immersive virtual environment. It is a scalable, autonomous, and decentralized technology that allows us to connect to an environment that is digitally enhanced. This environment could be real-time augmented or entirely created by artificial intelligence. Generally perceived merely as a new way of communication, gaming, and entertainment, the metaverse is transforming itself into a technology that can be utilized in any industry. From healthcare to tourism, from education to entertainment, this technology is spreading its legs very fast. However, with the enormous growth, there comes concerned that hinder its fast adoption. There are concerns regarding the high computation devices needed for real-time environment simulation, while some raise ethical concerns regarding the same. Table 03 Summarises the issues faced in the mass adoption of Metaverse.

Challenges in Metaverse Adoption	Description
Technical Challenges	Metaverse requires a high computational power to being an accessible reality. Using a high-performance computational power as well as storage on a large scale is challenging,
Ethical Challenges	Ethical concerns against metaverse are raised, claiming that high usage of metaverse will lead humans away from the nature and its laws.
Economic Challenges	Highly specialised infrastructure, which includes high performing devices are required to make effective use of Metaverse. The cost involved to setup such infrastructure bars its mass adoption.
Privacy and Security Challenges	The devices that interact with each other in the metaverse generate a large amount of data. Handling such a large amount of data raises concerns.

Legal Challenges	Numerous legal concerns are raised in relation to the metaverse, such as those affecting civil law, data security, and intellectual property rights.
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Table 3: Open Issues Involved with Metaverse adoption.

5.1 Technical Challenges

The tools and technologies that are principally responsible for creating the user experiences that make up the metaverse include virtual reality (VR), augmented reality (AR), and haptic gears, which provide the sensation of users' bodily movements and reaction to the experience. The software systems that allow for the development of those experiences also influence the metaverse. It will immerse people in a virtual environment with real-time events. a completely virtual scene with a lifelike avatar and elaborate attire Based on the information gathered by the sensors, all of these components will be displayed in real-time. We want high-performance data transfer with enormous bandwidth and low latency to carry out all these operations on such a massive scale. Best-performing hardware is required, and along with it, new software and algorithms are required [Hendaoui, 08]. This comprehensive upgrade of the complete system is a laborious process with a high level of technical complexity. In addition to the accessibility of technology and software, the challenge is in having high-quality and high-performance models that can achieve the necessary retina display and pixel density for a realistic virtual immersion.

5.2 Ethical Challenges

People frequently lose bodily awareness when using virtual reality, which might result in an altered perception of time when comparing the real world to a virtual setting. Due of the complete immersion, users could unwittingly spend more time in the Metaverse. The risk of a distorted sense of time makes it essential to develop mechanisms that will keep users in check with the outside world. An immersive virtual world, where everything is according to our needs and wishes, will make us spend most of our time inside it and will increase the distance between humans and nature. Bojic [Bojic, 22] says that the addiction to the virtual world will increase when the metaverse will become a mainstream technology and a person may not like the real world. He also raises concerns over the damage it would do to human creativity and imagination. People will be able to interact with a virtual environment in the metaverse. Everything would be created by humans, including the avatar, the clothing, and the skill colour. The biggest problem is the potential for falsifying voice, video, and face traits, which will misrepresent personal identification. The ethical issues present in the actual world may also be introduced into this virtual one. Concerns have been raised about the diminished use of avatars with a dark complexion and female representation. This raises questions about racial equality and gender representation.

5.3 Economical Challenges

One of the most promising futures in the contemporary day is the metaverse. It has a wide variety of capabilities and can cater to any needs. For a better experience, the metaverse incorporates technologies including augmented reality, virtual reality, artificial intelligence,

head-mounted displays, blockchains, and the internet of things. Through the metaverse, people may interact and carry out certain tasks in a real-time setting. A specialized infrastructure, which comprises high-speed hardware and software, is needed for latency-free real-time calculations. This technology is out of reach for many people since it is extremely expensive to produce and build up the infrastructure necessary to make it available to everyone [Kusuma, 22].

5.4 Privacy and Security Challenges

Organizations and companies are innovating to bring out methods that can revolutionize the methodology to provide users with a secure and safe digital environment but yet the success is not muchly appreciable. With the arrival of the open collective virtual world, the concern regarding data privacy and its security has increased. In a metaverse-based virtual world, the number of people interacting with each other will increase tremendously. The data of this interaction and the personal data of the interactors constitute big data. Big data is too large to be analysed by conventional data processing methods. The conventional cryptographic to secure the data do not work as desired in the case of big data and this raises security and privacy concerns [Wang, 22b]. Regulators and public authorities are debating whether new policies for personal verification should be adopted that can help to secure cyberspace.

5.5 Legal Challenges

One of the most recent innovations that have started to confront regulators and policymakers is the metaverse, and it almost certainly will continue to do so. Although the metaverse and its most well-known sibling, the internet, have many of the same legal difficulties, the metaverse is different because of the way many technologies have come together. The first, under no specific order of importance, has to do with controlling user behaviour. They could come back and pursue you using other avatars [Moradiberelian, 22]. They could even pretend to be someone else to obtain private information. Most of the time, existing laws assume that victims are real people and not computerized avatars. Another issue is that human imagination would likely be the sole constraint on creativity in the metaverse. Users will create more content as a result of a platform's increased capacity for innovation and functionality. There is no lack of illegal content on the internet, and IP owners sometimes choose not to pursue legal action against various parties since doing so would be expensive. Therefore, it is imperative that business stakeholders in the metaverse carefully consider the IP strategy they would like to implement and how to best combine innovation and commercialization.

6 Open Research topics and Future research Directions

We now include numerous AI research directions with an emphasis on the metaverse. Conversational AI-powered virtual assistants for consumers and employees may be used for a variety of particular objectives, including multi-level philosophical discussions to improve user interaction. This sets them apart from standard virtual personal assistants, which are designed for a wide purpose and include basic dialogue management. Conversational AI, a group of technologies that includes automatic speech recognition, language processing, advanced dialogue management, and machine learning (ML), can provide human-like interactions in the

metaverse by recognising speech and text, understanding intent, translating between different languages, and responding to conversations in a way that mimics human speech.

The choices are made by AI agents in many AI-enhanced services and apps in the metaverse, which are powered by ML models that operate as opaque black boxes with no interpretability or explainability. Because they are unable to fully comprehend how and why an AI model makes a forecast, metaverse developers, virtual world designers, and consumers are likely to place blind faith in them. With end-to-end process monitoring and accountability, Explainable AI (XAI), a collection of tools and techniques for describing AI models, analysing their anticipated effects, defining model transparency, and reviewing results, addresses these problems by allowing human users to fully comprehend and trust the AI models.

The majority of contemporary metaverse initiatives restrict users' ability to discover, possess, and alter virtual objects. With the aid of AI, users will soon be able to swiftly and simply create hyperreal objects and content. Users may continually combine various types of hyperreal items to create original experiences and inspire creativity. In light of this, the fusion of VR with AI-based content creation can enable total immersion in alternate universes. In this situation, everyone should be able to afford AI technologies, and they should have user-friendly interfaces. When users create hyper-real media contents, there are risks and negative threats to individuals and society that must be reduced. To do this, ethical issues related to user-generated metaverse must be thoroughly investigated with limitations and controls between users and outside organisations.

7 Conclusion

Since Facebook planned to rename itself as Meta, the term "Metaverse" has become popular in the IT sector. Users can communicate with one another, play, earn money, and buy in the network of linked, realistic digital settings known as the metaverse. This cutting-edge technology is the outcome of a number of earlier technologies that served as the building blocks for metaverse technology to develop. It all began with the idea of binocular vision, developed into a well-known fiction subject, and then, with the development of virtual reality and the internet, became a reality. This chapter analyses the various business uses of the metaverse as well as current market trends. This report also outlines the difficulties encountered in the rapid uptake of metaverse. After analysing this study, we found that the metaverse may be used for a variety of purposes besides serving as a brand-new social media platform, and that this cutting-edge technology may still be used to address a number of issues and further research in the future. The study is concluded by mentioning the industry's possible use of metaverse.

CONFLICT OF INTEREST STATEMENT: -

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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