



A Comprehensive Review of Metaverse: Taxonomy, Impact, and the Hype around It [†]

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Abstract: There has been widespread interest in the concept of the metaverse in recent years. The aim of this comprehensive review paper is to provide an in-depth analysis of the taxonomy, technological foundations, and historical evolution of the metaverse. The study explores both the positive and negative dimensions of the metaverse, including ethical dilemmas, using a robust analytical framework. In addition to studying the metaverse's impact on various sectors of society and the economy, this study offers an insight into how it will develop in the coming years. A notable highlight is the exploration of the estimated revenue forecast for metaverse money-making, projecting a substantial 40 billion USD by the 2030s. Further, the paper examines cyberbullying within the metaverse, shedding light on the unique challenges it poses. The hype surrounding the metaverse has also been analyzed, as well as its implications for the broader technological landscape.

Keywords: metaverse; augmented reality; virtual reality; interactive environment; hype analysis



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1. Introduction

The term “metaverse” is relatively new to the common vernacular of technology critics and academics; it was originally used in Neal Stephenson’s 1992 novel *Snow Crash*. It is positioned as the internet of the future, enabling users to communicate, work, meet, play games, and socialize by fusing many virtual locations into a 3D universe. The word “metaverse” is formed by combining the word “universe” with the prefix “meta-”, which implies transcending.

It talks about a fictitious artificial environment connected to the real world that can be viewed using augmented reality goggles or virtual reality headsets, allowing one to see [1]. In a virtual world, millions of individuals engage with one another. They carry this out via either utilizing their real-life identities or, less commonly, by developing new virtual identities that are often unrelated to their real-life identities.

The observed trend has prompted speculation suggesting an imminent development of comparable significance to the advent of the internet [1]. Presently, this phenomenon has gained widespread global attention, compelling numerous businesses to adopt a novel narrative for the construction of their metaverse, to provide their clientele with an engaging and compelling experience, as shown in Figure 1, where a newspaper article discusses the surge in demand for skills that complement the metaverse.

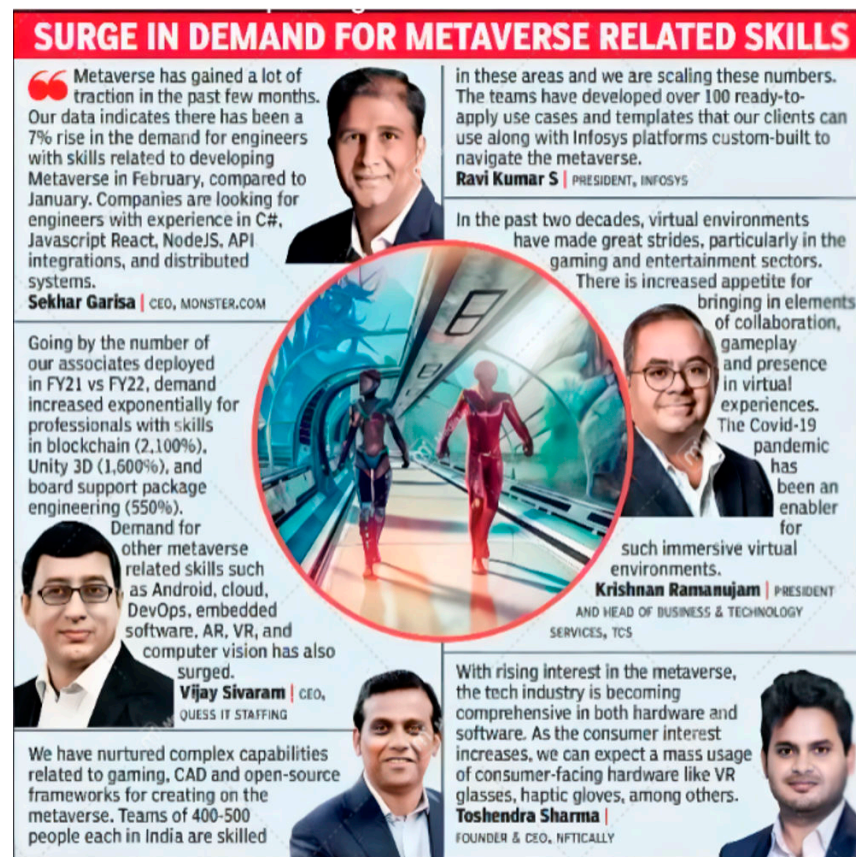


Figure 1. A newspaper article highlighting the surge in demand for skills complementary to the metaverse.

The metaverse is becoming more and more popular by the day, to a degree where global K-pop sensation BTS debuted their newest song, “Dynamite”, in the metaverse video game “Fortnite”. The literature seems to have generally offered an implications-based perspective on many aspects of the metaverse where studies have analyzed the transformational impact from institutional and societal viewpoints, highlighting both challenges and undesirable impacts on users [2].

The present research provides a multi-perspective narrative on the numerous opportunities, difficulties, and constraints facing organizations, people, and institutions, acknowledging the nascent character of the academic discourse on the metaverse. Metaverse shifts are now integrating the virtual and physical worlds. The excitement that is surrounding the metaverse is intensifying. According to a recent Statista analysis from 2021, the key dangers of the metaverse are addiction to virtual reality, privacy concerns, and mental health problems. These are the three main worries among internet users globally [3].

In an era marked by the metaverse’s transition from a theoretical concept to a tangible digital environment, a comprehensive examination across its multifaceted dimensions becomes imperative [4]. This study is dedicated to advancing the comprehension of the metaverse, emphasizing its relevance to education, decision-makers, businesses, and the broader public grappling with the navigation of this uncharted digital phenomenon.

The term “Metaverse” elicits two primary conceptualizations, akin to the immediate associations evoked by the term “Web” [5]. Nevertheless, a more nuanced perspective recognizes the existence of distinct metaverses, denoted with a lowercase ‘m,’ each exhibiting unique characteristics. For instance, one may draw a comparison between the metaverse of a first-person shooter (FPS) game and that of a fashion boutique. In essence, the metaverse and its constituent “metaverse sites” parallel the structure of the web and its individual web pages, as elucidated in the comparative analogy [6].

In response to a burgeoning trend among businesses eager to integrate and construct their respective segments within the metaverse, intending to deliver an engaging consumer experience, it becomes imperative to comprehend the metaverse's role in fostering interactive services.

The metaverse, by redefining communication and introducing a novel conception of “social life”, promises a heightened experiential dimension. Nevertheless, an underlying inquiry surfaces regarding the propensity for metaverse adoption and whether there exists a comprehensive understanding of the potential physical and mental implications it may exert on individuals. This discourse endeavors to explore the concept of the metaverse and its implications. The findings of this research illuminate the metaverse from a consumer-centric standpoint while delineating the associated threats. Such insights are instrumental for companies, serving as a framework to perceive these challenges and subsequently surmount them, thereby establishing a metaverse that is secure, safe, and aligned with ideal standards [7,8].

2. Taxonomy of Metaverse

The more one searches for information about the metaverse, the more one encounters enthusiastic descriptions of seamless connectivity and futuristic gadgets [9,10]. Metaverse can be divided into several categories. The following subsections name and explain these categories in detail. Additions to online platforms and ideas that will be included into the metaverse in one way or another, such as social media, mobile phones, augmented reality, and virtual reality games [11], have been studied by certain writers. Figure 2 shows the different types of metaverses present.

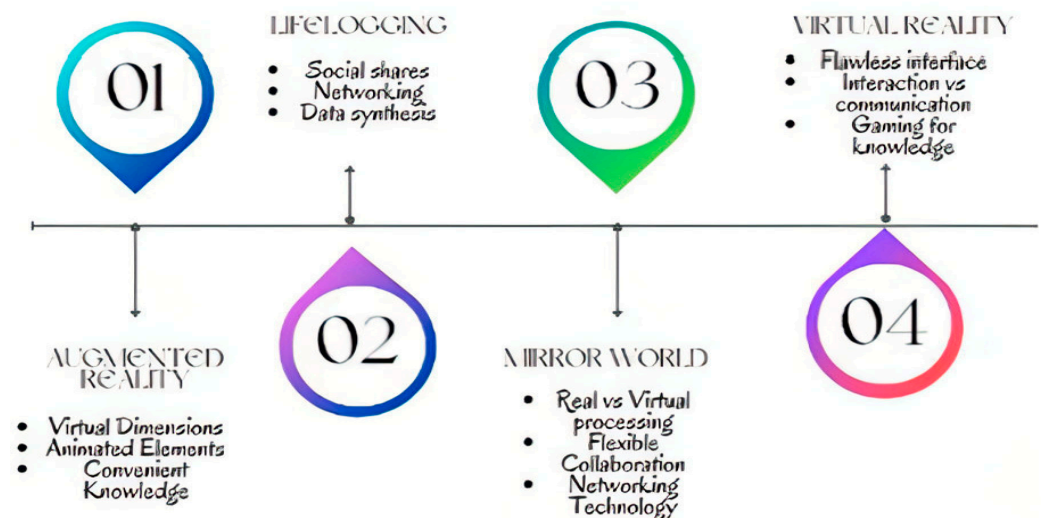


Figure 2. Types of metaverse.

2.1. Augmented Reality

VR is unique because it makes a not-real world. But AR? It boosts real things and lights them up with computer-made pictures. This makes a back-and-forth user experience [12]. The adventure of *Pokémon Go*, an AR game developed by Niantic, is the most well-known application of augmented reality in recent times. It gave users the ability to explore their city and catch Pokémon, simulated animals that spawn in their actual surroundings. With a smartphone or even specialized augmented reality smart glasses, objects may be scanned and examined [13,14]. Through a display, augmented reality (AR) allows users to see natural objects come to life in a holographic manner. With the aid of these tools, a user can engage with an actual object as though it were alive. As seen in Figure 3, the user obtains all the information about the object they view after viewing it. According to Antonioli et al., augmented reality (AR) is a technology that improves the real-world

environment by superimposing computer-generated content on it. It has professional uses in several industries, including manufacturing, retail, healthcare, and education [15]. These days, businesses use augmented reality (AR) to increase worker safety by offering virtual training simulations and allowing workers to see how the equipment will work before it is created.

2.2. Virtual Reality

The way we interact with and experience digital surroundings has been completely transformed by the cutting-edge technology advancement known as virtual reality (VR) [16,17]. VR stands for virtual reality, and it is a graphical user interface that lets people utilize different VR equipment to interact with a simulated virtual world. It creates a simulated 3D virtual environment by utilizing the ideas of a 3D graph, multisensory interaction technology, and high-resolution display technology [17,18].

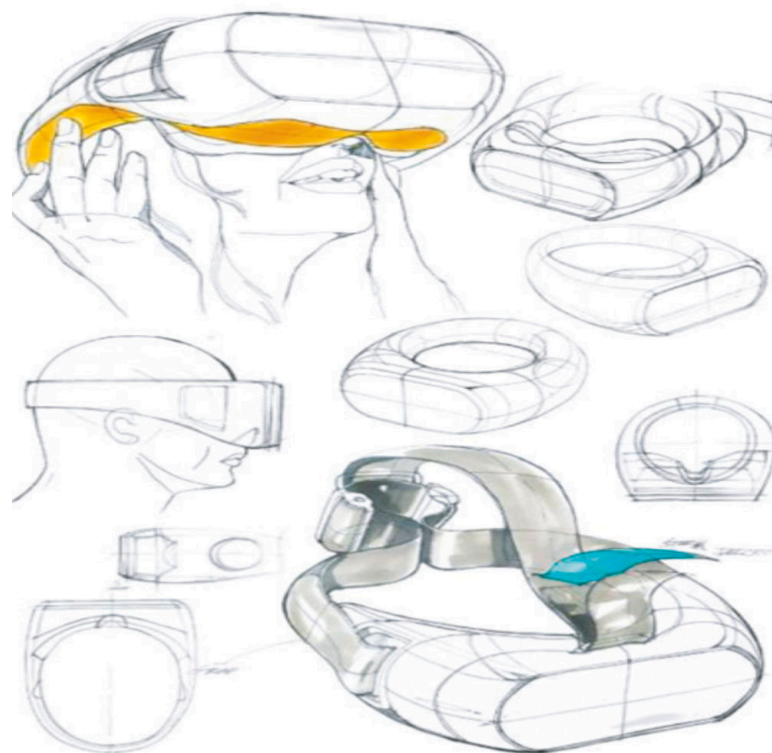


Figure 3. Concept drawing of VR goggles [19].

Users engage with a virtual environment that is so immersive that it induces a dream-like experience, leading them to feel as though they are physically there in the simulated world and that all interactions occur in real-time. Virtual reality (VR) technology simulates human activities in a virtual environment through the use of specifically developed input devices, such as motion trackers, wired gloves, body suits, VR headsets, and 360 VR treadmills. Virtual reality, or VR, has been widely employed by the gaming industry since its launch to produce exciting games, like *Second Life*, *Batman: Arkham VR*, *Half-Life: Alyx*, and several more. These innovations are gradually being implemented to help in the fields of sports, education, mental health therapy, medical training, and the military after demonstrating their viability in the gaming community. A concept sketch of a VR headset, which is needed to see and interact with a virtual world, is shown in Figure 3 above.

2.3. Lifelogging

One way to enhance the inner world is by lifelogging. In the lifelogging community, a lot of people use smart gadgets to post daily life logs online or on cell phones [20]. The trend of using different types of data created from daily activities to analyze, record,

organize, store, and share information on lifestyles is currently gaining traction. Productivity, adaptability, relationship orientation, and modification are benefits of this daily digitization [21,22].

The practice of “lifelogging” has been around for a while, having begun as the publication of journal entries on social networking sites such as Facebook, Instagram, and Twitter. Recording events has gotten easier and faster with the rise of wearable technologies in recent years, along with improvements in storage, cloud services, location awareness, and sensing technology.

Additionally, it has resulted in a more effective manner to use technology for lifelogging and diary recording. In general terms, lifelogging is the practice of documenting one’s own life, including everyday occurrences, using wearable sensors like cameras, accelerometers, and others [23,24]. Although most people are aware of lifelogging, they rarely give it any thought as to how it might be used to alter behavior. The convergence of technologies led to the creation of this type of lifelogging.

For instance, more people are utilizing cameras in their personal spaces, such as their houses or vehicles, to capture unanticipated events like accidents or assaults or to keep an eye on life-threatening circumstances to receive medical attention [25]. Research on pervasive computing has recently advanced, repositioning SenseCam as a monitoring and memory assistance for people. Wearable cams are examples of small gadgets that passively and automatically record daily activities. A deeper examination of daily activities is possible using data captured by video cameras at precise times [26,27].

Also, information about behavior patterns can be inferred from data collected over extended periods. Lifelogging analytics has the potential to prevent diseases like obesity, depression, and other conditions associated with harmful lifestyle choices. Furthermore, this kind of examination may assist in preventing older people’s decline in intellectual and functional abilities. The majority of lifelogging research has been concentrated on one area [28].

2.4. Mirror World

The term “mirror world” refers to informationally enriched virtual representations of the real world, a sort of simulation of the outside world [29,30]. Mirror reality is a metaverse that gives a virtual world the look, feel, and organization of the actual world. It is not the same as reality, but rather an efficient expansion of reality. Lifelogging technologies such as mapping, modeling, and geospatial tools and sensors, as well as location recognition technology that connects actual and virtual environments, enable the mirror world. The mirror world is made feasible by GPS-based map information, diverse data taken from the real world, and mapping technologies that connect them.

3. Impact of the Metaverse

The word “metaverse” always brings up the question of whether it will be the next big step in the evolution of our technology and way of living our day-to-day lives, and the answer to which calls for checking the impact on productivity, time efficiency, health, education, business, work opportunities, social life, communication, etc. In this section of this study, we will take a detailed look into the impact the metaverse might have on us by dividing it into two sections: Positive Impacts and Negative Impacts. Figure 4 below shows a Venn diagram depicting the three environments in the metaverse.

3.1. Positive Impacts

Users can engage with an environment personalized for them and hence feel that they are living in their world, and they have control over their lives. The metaverse allows three types of environments, realistic, unrealistic, and fused environments. The realistic metaverse reflects the real world in terms of geography, laws of physics, and the three-dimensional elements. This includes having a setting of exact life-like recreations of places and elements in our world or a completely different setting that remains faithful to our

history, geography, and laws of physics such as gravity and speed of various elements. An unrealistic environment contains no limits such as the laws of physics and beings found on earth. A fused environment adds elements of an unrealistic environment to a realistic environment, such as many fantasy worlds like wizarding worlds, superheroes, dragons, etc. Additionally, these settings can be put behind a paywall and treated as a virtual travel destination and provide personalized virtual parks, theatres, gyms, etc., suiting each person.

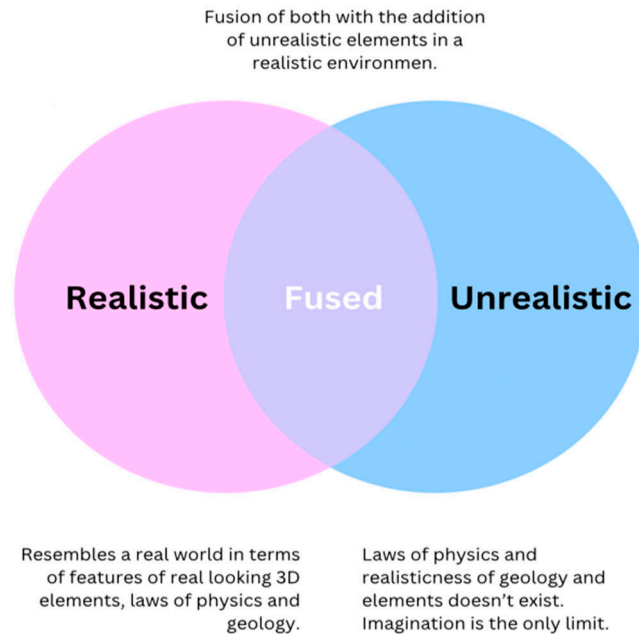


Figure 4. Venn diagram depicting the three environments in the metaverse.

Education, along with businesses, can be enhanced with the help of “meta meets”. Augmented reality, virtual reality, lifelogging, and mirror worlds are accelerating the utilization of the metaverse [4]. The extreme conditions of the COVID-19 pandemic forced companies and schools to make a shift to the digital realm entirely with the help of online conferencing platforms like Zoom, Microsoft Office, WebEx, etc. Metaverse, with the help of VR, creates a skeuomorphic room where the employees and employers can be logged in at the same customized Metaverse via their residence. The term “skeuomorphism” is a UX design idea that incorporates objects and environments that resemble the real world. [9]. Education can benefit from skeuomorph classes which give the environment and feeling of a physical classroom. Surgical trainees and neurologists better understand the critical concepts involved in neurology by visualizing the human brain in a virtual environment [4,21]. Figure 5 below shows the various sectors in the metaverse with an explanation of their working. The percentage of populations across all generations willing to work in the metaverse is shown in Table 1 below:

Table 1. Percentage of population across all generations willing to work in the metaverse [31].

Generation	Birth Range	Willing to Work in the Metaverse
Gen Z	Born late 90s–2010s	51%
Millennials	Born mid 80s–mid 90s	48%
Gen X	Born mid 60s–mid 80s	37%
Boomers	Born 40s–mid 60s	28%

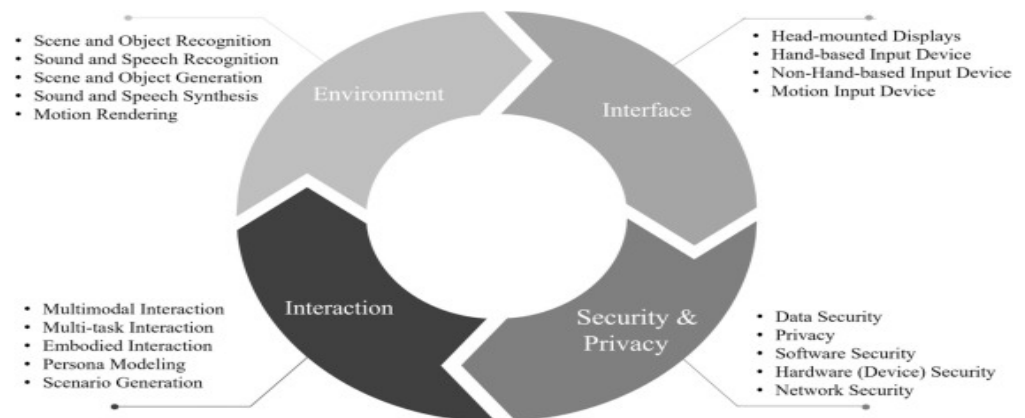


Figure 5. Sectors in the metaverse with an explanation of their working.

The entertainment industry was also hit by the global pandemic and now shows a 33% drop in moviegoers in the year 2022 [32]. This alludes to the 48% rise in interest in stream-at-home content, which opens up a big market for the metaverse. With the help of VR goggles or a skeuomorph, rooms with the physical features of a crowd-filled theatre or even a home theatre can be created. The metaverse also supports UGC (user-generated content) and can become a platform for new talent to rise. This is not limited to the movie industry but also to the sports and music industry. The *Taylor Swift: The Eras Tour* movie collected USD 1.04 billion as of the second week of December 2023, showing there is a huge market for a virtual means of concert for those unable to fly to physical concerts.

Nike, in collaboration with the Roblox online experience, opened a virtual replica of its Beaverton headquarters in 2021 where they offered consumers virtual shoes, apparel, and accessories [33]. The metaverse opens up new gates for marketing and collaboration via VR as it can take brand–consumer interactivity to a new level. Consumer information is a big part of branding and marketing, and with the metaverse’s infrastructure, in-depth relevant customer information can be made available to the big market.

Moreover, the world of gaming with the help of MR and VR can take players into the environment of the game and would no longer need a console and controller as the player’s environment could be morphed into that level and environment of the game they are playing. This tech could be achieved by MR (mixed reality), VR (virtual reality), or skeuomorphism for a multiplayer gaming mode. Figure 6 below shows that the estimated revenue in metaverse money-making, in US dollars, by the 2030s, will be USD 40 billion.

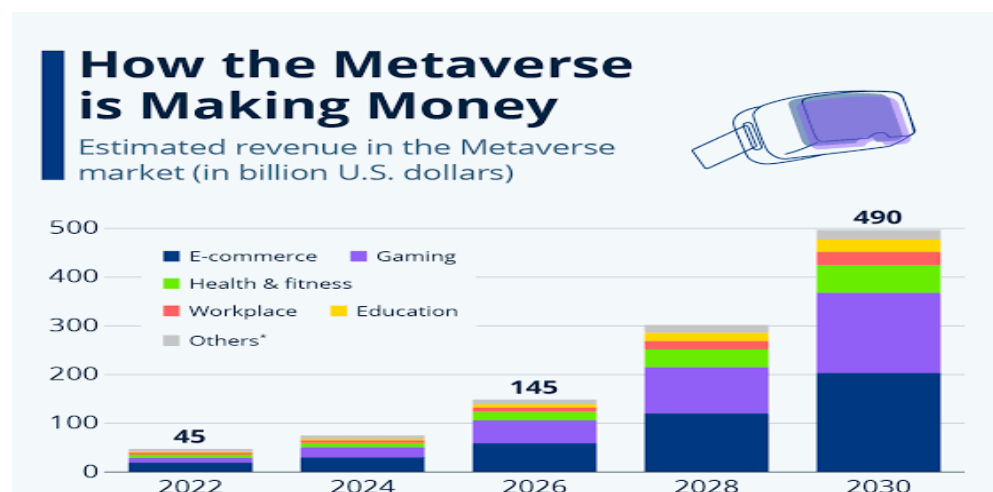


Figure 6. Estimated revenue in metaverse money-making in US dollars by 2030s [34].

3.2. Negative Impacts

COVID-19 created a big in-person communication gap and with the metaverse, and the gap is expected to be widened. According to statistics taken for research [35], 85% of employees claim they are more motivated when their employers contact them in person, and 72% feel face-to-face feedback improves their performance.

Psychiatrists believe that an increase in serious mental health conditions is expected due to these pseudo-virtual interactions as loneliness is proven. According to [36], there seems to be a connection between mental health and loneliness:

- Loneliness can increase the risk of early mortality by 26%;
- Research states that 60% of chronically lonely humans end up having mental distress;
- Loneliness also leads to inadequate sleep and elevated blood pressure.

Another point to be added is that people might use the metaverse as a means of escapism. The term “escapism” refers to the tendency to use entertainment or such as a means to seek distraction from reality.

Humans are infamous for adopting technologies and methods made to make something more efficient and solve short-term problems in their day-to-day lives in a way that changes the way we function over the years without ever considering the long-term effects, proving an over-dependency on anything, even if it is good for us; for example, smartphones, television, etc., have always been harmful to humans in the long run, and the same is cautioned for the metaverse.

MR (mixed reality) is an ideally realistic take on the real world, where users can no longer differentiate physical elements from virtual elements [37], which makes the long-term dependency on the metaverse more concerning. Figure 7 below shows the risk in health conditions due to an over-dependency on smartphones which serves as a warning for the metaverse as well.

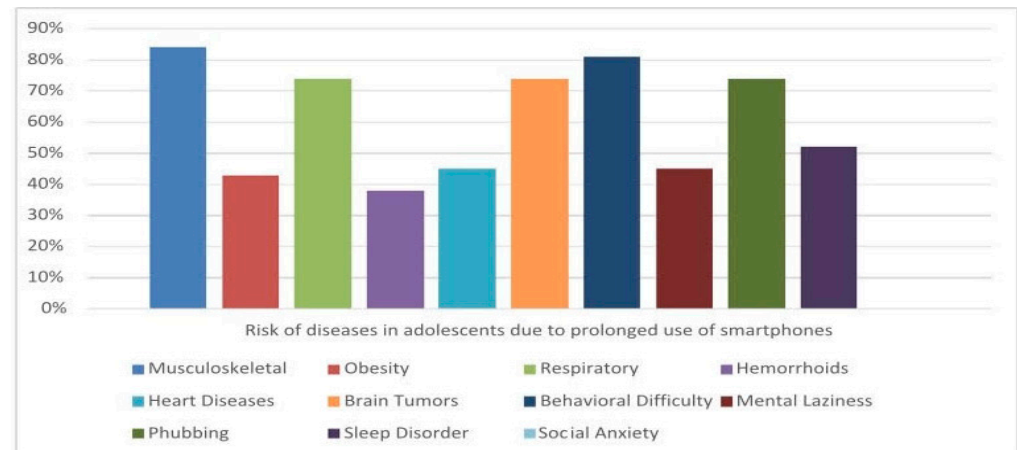


Figure 7. Risk in health conditions due to over-dependency on smartphones.

We can also look at the way mobile phones have reduced physical activities in children and adults which has led to an increase in the number of diseases and disorders which we can see in the report [31]. Internet users across the globe have become more concerned over our data and privacy. With social media already being a big data collector for big businesses and markets, the metaverse is expected to be even bigger and more accurate and feeding our data to the big markets. According to statistics, 62% feel they no longer trust social media with their data, and the metaverse would have to earn their trust first, and rightfully so, if we look at the many times data have been leaked or sold online.

Over the years, social media has become a breeding ground for such crime, to an extent that a whole new crime department was needed to be formed. And, it will only rise with the metaverse. Technical solutions to stop cyberbullying include automatic screening, moderation, algorithms, blocking, bot-checking, filtering on words, and filters [38]:

- University students in Canada, in 2016, created a VR application to deal with harassment and bullying;
- FearNot! was created by Warwick University students with researchers to give a VR platform for opposing bullying;
- Stavroulia, also known as “A 3D virtual environment for training teachers to identify bullying,” has been created.

The Air Force of the United States is known for implementing VR to handle sexual harassment and anger management.

These steps with active learning and spreading this information are the key to preventing cyberbullying and harassment of all kinds in the metaverse (see Figure 8). It is majorly expected that by the 2030s, the metaverse will be able to recreate all the things we do in this physical reality in the virtual reality of metaverses, along with so much more. This sparks the debate if the metaverse is going to be our next big step and if we are even fully aware of it before it consumes us.

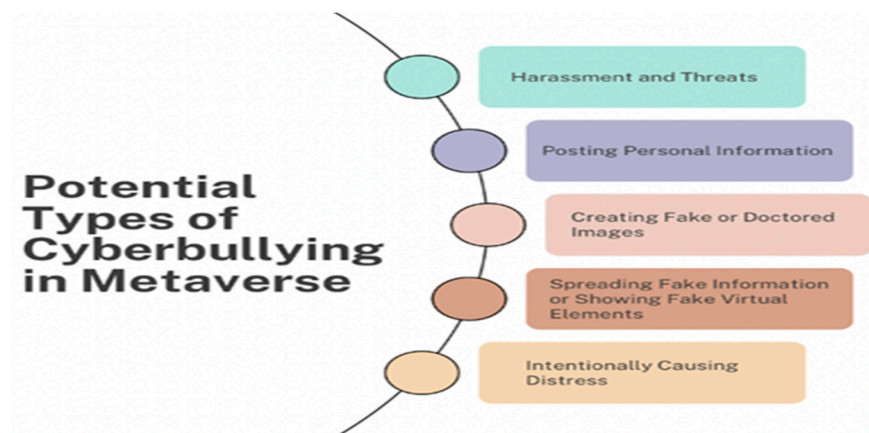


Figure 8. Types of cyberbullying in the metaverse.

We generally see all revolutions as a mechanism from the perspective of new brighter futures being formed, and we tend to ignore the potential downsides. The underlying use of the metaverse is to make it easier for everyone and have a brighter impact on people, proving we should not be naïve in considering the potential risk for users.

The history of mankind proves if one form of revolution touches its onset, it becomes very difficult to stop and goes on to become “the next big step forward”. The metaverse is likely to have the same fate and become our reality. We, as humans, should focus on the potential the metaverse has and think about how to use it to increase happiness, productivity, sustainability, virtual work systems, and culture rather than focus on just the business side of it.

4. Survey on the Hype of the Metaverse

Since the World Wide Web (www) was established by Tim Berners-Lee in 1989, the internet has undergone substantial advancements. A more recent creation that utilizes the internet is the “Metaverse”. Interest in the metaverse increased dramatically after some news announcements were made. The spike in metaverse-related queries is shown in Graph 3, which was obtained from Google Trends Data [14].

Numerous other businesses have also indicated interest in building and developing their metaverse, including Nvidia, Unity, Roblox, Tencent, and many more.

Figure 9 below represents the number of Google searches for the Metaverse during the past 12 months. This information may be found in [39] and was gathered from Google Trends Data. It can be observed that October saw a sharp rise in searches in response to news releases from Microsoft and Facebook.

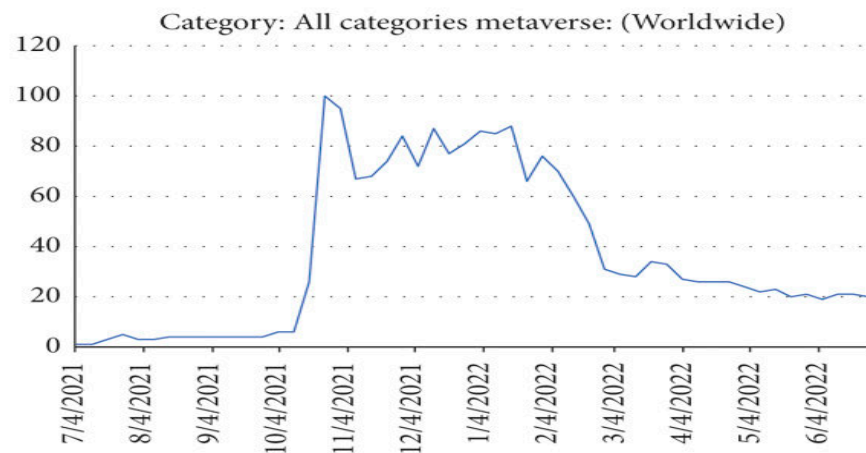


Figure 9. Number of Google searches for Metaverse.

Multiple health professionals, including psychologists, therapists, neurologists, general physicians, and more, were consulted to get their thoughts on the metaverse to better understand how it might change people's perceptions and leave a lasting impression. This was carried out to investigate further the potential effects that a metaverse could have on people.

An online survey was undertaken after the health professionals' consultation to better understand people's perspectives on the metaverse and how they believe it could impact their lives.

The survey posed the subsequent queries:

- (i) Q1. In what age range do you fall?
- (ii) Q2. Can you describe the metaverse?
- (iii) Q3. Do you find the idea of a virtual world or metaverse exciting? (refer to Figure 10)

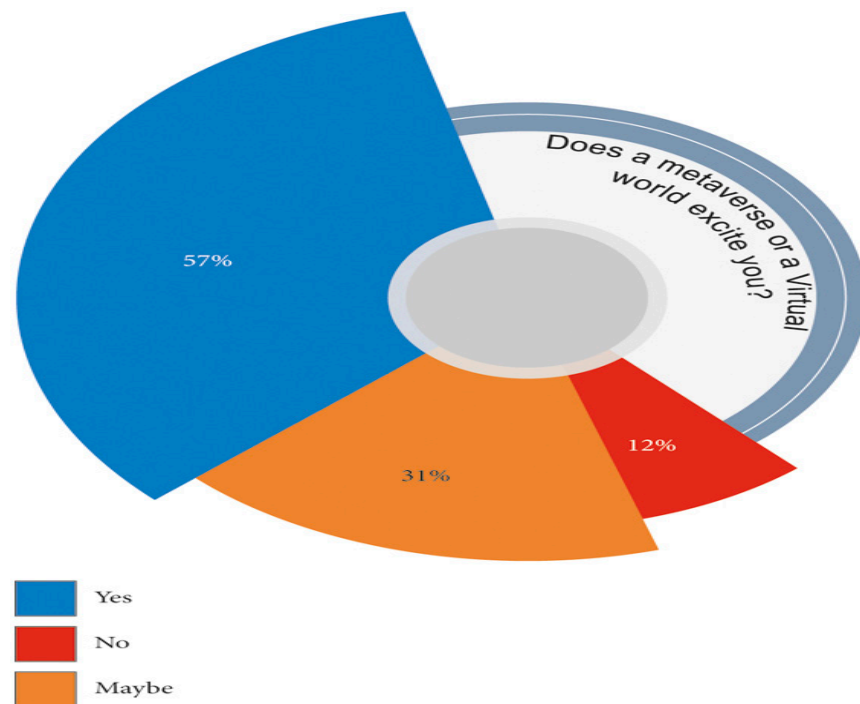


Figure 10. Poll of the question: does a metaverse or a virtual world excite you?

The metaverse may or may not be worth the hype, and people's perspectives on this matter can differ greatly. The solution depends on several variables, including unique

viewpoints, expectations, and particular use cases. Figure 10 below shows a pie chart of a statistical result asking people if they are excited about the idea of a virtual world, i.e., the metaverse.

5. Conclusions

This review paper provides a thorough examination of the multifaceted aspects of the metaverse, encompassing its technological foundations, historical roots, advantages, drawbacks, and ethical implications. The analysis sheds light on the intricate relationship between the metaverse and various facets of the economy and society, offering a thorough understanding of the impacts associated with this emerging phenomenon. Moreover, the paper delves into the pervasive hype surrounding the metaverse and its profound implications for the broader technological landscape.

As we reflect on the findings presented in this review, it is evident that the metaverse holds significant potential to reshape how individuals interact, work, and engage with digital environments. However, the study also underlines the importance of addressing ethical concerns and potential drawbacks associated with the widespread adoption of metaverse technologies.

Looking ahead, future research in the field of the metaverse should focus on the socio-economic implications of the metaverse, including its impact on employment patterns, privacy, and digital inclusion. Furthermore, researchers should explore the potential synergies between the metaverse and other cutting-edge technologies, such as artificial intelligence, blockchain, and the Internet of Things. Understanding how these technologies intersect and complement each other is crucial for unlocking the full potential of the metaverse.

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