DERLEME

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SANAL GERÇEKLİĞİ VE ARTIRILMIŞ GERÇEKLİĞİ BİR SONRAKİ SEVİYEYE TAŞIMAK: KARMA GERÇEKLİK İLE YAPAY ZEKA

Taking Virtual Reality And Augmented Reality To The Next Level: Artificial Intelligence With Mixed Reality

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Özet

Sanal gerçeklik (VR) ve artırılmış gerçeklik (AR) önemli bir heyecan vermişti, ancak Karma gerçeklik (MR) hayal ettiklerinin ötesinde otantik bir deneyim sunmakta ve bu heyecan verici deneyimi bir sonraki seviyeye taşımaktadır. MR, sanal verileri doğal nesnelerle denkleştirerek ve gerçekçi fiziksel ve duygusal etkileşimler oluşturarak, dijital nesneler gerçek ortamlarda doğal nesneler gibi konumlandırılmakta ve gerçek nesnelerle hizalanarak gerçek zamanlı olarak gerçekleşme sağlanabilmektedir. Metaverse'in ortaya çıkmasıyla, gerçeklik kavramları hem işletmeler hem de akademi tarafından yeniden tanımlanmakta ve vurgulanmaktadır. Metaverse, fiziksel dünyadaki varlığımızın bir kopyasını ve alternatifini oluşturarak var olabileceğimiz sanal ve geçişli bir yapı olarak tanımlandığından, ticari değer ve yüksek teknoloji yönlerinin yanı sıra mistik, manevi ve dini bakış açıları içerebilir. Bu çalışmada multidisipliner analizler ve değerlendirmeler ile sadece fizikselden sanala geçişin değil, aynı zamanda verilerin fiziksel konuma, nesnelere veya sensörlere aktarılması yoluyla sanaldan fiziksele geçişin sağlanabileceği sorgulanmaktadır.

Anahtar Kelimeler: *Karma Gerçeklik, Yapay Zeka, Sanal Gerçeklik, Artırılmış Gerçeklik, Metaverse*

Abstract

Virtual reality (VR) and augmented reality (AR) have caused significant excitement, but Mixed reality (MR) offers an authentic experience beyond what they have are imagined and it takes this exciting experience to the next level. MR collides virtual data with natural objects, creating realistic physical and emotional interactions so that digital objects are positioned like natural objects in real environments and positioning takes place in real-time by aligning with real things. With the advent of Metaverse, the reality concepts are being redefined and highlighted by both businesses and academia. Apart from business value and high-tech aspects, Metaverse can include mystical, spiritual, and religious perspectives, as it is defined as a virtual and transitive structure in which we can exist by creating a duplicate of our existence in the physical world and its alternative. Through multidisciplinary analyzes and evaluations in this study, the possibility to provide not only the transition from the physical to the virtual, but also the transition from the virtual to the physical through transferring the data to the physical location, objects, or sensors is questioned.

Keywords: *Mixed Reality, Artificial Intelligence, Virtual Reality, Augmented Reality, Metaverse*

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1. INTRODUCTION

The use of MR, VR, AI and AR are rapidly developed with innovative cutting-edge applications in many fields such as design, education, entertainment, military education, and health services. MR also includes auxiliary sectors in its usage areas. Thus, the field of design is dramatically changing, expanding, and evolving. These technologies will provide people receiving instruction in a physical environment with the opportunity to access the needs that the domain does not have virtually. The fact that the objects accessed are close to reality will increase the chance to experience in education. VR, AR, and MR applications aim to overcome the limitations of the physical environment in theory and can provide instant interaction with other physical environments at the speed of light. Unbelievably rapid developments in the innovative dimension of scientific applications do not yet provide definitive evidence on whether this will enable spiritual interaction or whether it will enable communication with angels, demons, and spirits of dead people or result in denial of all past arguments of metaphysical values and elements. For this reason, it is thought that future innovations in AR, VR and MR applications together with super AI should be evaluated. It is assumed that if such an opportunity and functionality is obtained, religious perceptions, faith and worship may be adversely affected. There has not been a study at the literature level on this issue yet. Therefore, this is a research question is set as such: *"Will VR, AR and MR innovative technology lead to interaction with spirit realms, jinn and angels when supported by super AI or result in complete denial of metaphysical values*?"

In this study based on the latest publications in the literature, we have started with setting up research problem and literature information; provided key conceptual definitions of VR, MR and AR; evaluated Security and privacy issues and key risks; briefed different applications in education, military, health, entertainment, and business; discussed the Metaverse with conclusion.

2. RESEARCH PROBLEM AND LITERATURE

When it is searched through Scholar database with the keywords "Mixed Reality, Artificial Intelligence, Virtual Reality, augmented Reality, Metaverse and spirituality" 217 publications are found none of which used all terms in the article header. We have found no study assessing possibility of interaction with spiritual realm or denial of all.

In fact, it is all about the conceptualization, theory and positioning of reality related paradigms. The transformation of reality perceived by sense organs into information redefines the concept of reality. The concept of reality determines what exists. The fact that perception can be influenced and misleading in its relationship with memory opens new dimensions in the concept of reality (Ipek, 2020). Many equivalents of MR technology emerged with the blending of VR and AR technology (Yengin and Bayrak,

2017). The key elements of VR had been discussed long before. The HTC Vive Pro Eye is the most equipped example of this technology, developed considerably since the first VR device called "Sensorama Simulator," invented by Morton Heilig in 1962. This headset, the best-known member of MR technologies, includes VR and AR technology, and can follow the user's pupil movements with external eye-tracking technology. This situation dramatically increases the success in the sensitivity of the use of technology. As it is known, all the VR technologies that make it possible to overcome the limits of physical reality involve the integration of the user into the virtual environment through various sensors and computers (Milgram & Kishino, 1994; Grau, 2003; Scoble & Isreal, 2017). After that, the user can navigate the environment positioned with head movements. This function, which is possible due to the communication between the head and the sensors through various methods, is being strengthened using innovative techniques. The newest technique introduced in this context is the eye-tracking technique, which detects the eyeball movements of the user, processes metric and navigation information, and thus increases the integration of the user with the objects in the virtual environment (Bayrak and Yengin, 2020)

With Industry 4.0 applications, the artificial functions of MR have also increased and diversified, as virtual and accurate data have collided in a similar environment in MR. With this method, while increasing the reality of virtual data, it is ensured that the existing natural environment is transformed into settings where virtual data can be used. Transformations also shape the perception of reality. This pass-through in perceptions of reality causes immersion, distortions in individuals' perception of reality. The next stage of this deterioration is that the individual forgets that he is in a virtual or physical environment. It is among researchers' ideas that the developments in this field can bring along various mental and physical problems. These efforts intersect with those offered by the Internet of Things. This mutual transformation causes many technologies such as digital twins, blockchain, and artificial intelligence to have new use areas. MR technology has been applied in diverse manufacturing and industrial sectors to visualize the digital models supporting teaching and training. Nevertheless, most of these MR projects mainly focus on users' experiences (Tang *et al.,* 2019).

Swalley (2015) aims to determine the effect of Metaverse and augmented reality concepts on online purchasing behavior. Retailing has transformed from traditional to electronic and then to virtual reality in which qualitative and quantitative methods were used together to determine the basic view of technology and consumer interest in retailing. In a study conducted by Ağralı and Aydın (2021), the emotions related to Metaverse were evaluated in the light of the data obtained from social media platforms. The tweets sent one week before and after Mark Zuckerberg's announcement that his company would change its name to Meta were evaluated and tweets sent in English with the hashtag "Metaverse" on Twitter were used as the data set. As a result of the study, it was explained that after Mark's speech, positive tweet rates decreased and both neutral

and negative tweet rates increased. Damar (2021) aimed at a bibliometric evaluation of metaverse technology, which has been discussed in the literature since the 1990s. The study was carried out by extracting the data of all documents between the years 1990-2021 from the Web of Science base, and it was deduced that Metaverse will be included in many areas of human life in 15 to 20 years and will shape life by taking advantage of the opportunities of developing technology. Kalkan (2021) aimed I his study to obtain inferences about the development and future of sports and the phenomenon of sports in the Metaverse universe, which is a new concept. While examining the concept of metaverse chronologically, he conceptually discussed the issues of being a coach, athlete, referee, and spectator in the Metaverse era. According to the results obtained from the study, the Metaverse universe was found to be important in terms of sports and its stakeholders in the context of the development of sports and exercise. Kuş (2021) aimed to determine the factors that are effective in the emergence of facts about the concept of Metaverse in his study. Within the scope of the study, the positive and negative factors were listed, and the results of the perception of opportunity and threat were explained. Nalbant and Uyanık (2021) aimed to examine Metaverse technology both in computer vision and general point of view. In addition, they emphasized that these technologies should be more accessible to the society, suitable for people at all economic levels of the organization, and cheap cost products should be developed and made suitable for use by all people. Ozkahveci et al. (2022), on the other hand, predicted that the concept of Metaverse increases every year throughout the world and within the scope of the relevant period, and the world can adapt quickly to this new virtual society.

As it is evident from the above studies in the literature, it is possible for computers to have the capabilities mentioned above and to develop themselves, thanks to the AI technology. As with AR, privacy is a significant concern for VR. The highly personal nature of the data collected, namely biometric data such as iris or retina scans, fingerprints and handprints, face geometry, and voiceprints, is a primary VR privacy concern (Kaspersky, 2021):

- *Eye-tracking:* Data can be valuable to malicious individuals. Knowing precisely what he or she is looking at can help an attacker reveal the user's valuable information, thereby recreating user actions.
- *Finger tracking:* The system records and transmits fingerprint data, indicating fingers typing a PIN code. If the attacker can capture this data, they can regenerate the user›s PIN.

Anonymizing VR and AR tracking data are nearly impossible, as people have unique movement patterns. VR and AR tracking data such as zip codes, IP addresses, and voice traces should also be considered potential "Personally Identifiable Information" (PII). These may be considered PII as external parties may use this information to identify or track an individual's credentials. Canadian Chanelle Siggens was recently harassed

verbally and physically by another player while using a VR headset. Siggens warned the player about this incident. The actress who harassed Chanelle Siggens, on the other hand, continued the harassment by ignoring the warnings and said, *"I will do what I want"*. After a while, the abusive player walked away from Siggens. With Metaverse and VR, this event raises concerns that cyberbullying, which is already a severe problem in the cyber world, will reach dangerous levels. According to the research, violations disturb the players every 7 minutes in VR-based games (Frenkel and Browning, 2021).

The person may be more obese because they can handle everything in the fantasy world. Loneliness and obesity await humanity in the Metaverse. As a result, many new types of diseases may emerge. It is imperative to consider all these with their pros and cons under academic studies. If used for good purposes, technology serves good and evil if used for immoral purposes. Instead of being against technology, we need to think about using it following our ideals. The problems are now in question in the metaverse universe based on AR, VR, and AI. Institutions and companies are in a big race as the concept of Metaverse requires this, it is about how you can work effectively. These are the questions that the concept of Metaverse deals with:

- Which imagination will they bring to the metaverse universe?
- What kind of experiences will other people face?

When we start talking about these questions, the Metaverse will find its place in real terms. We suffer a lot from the game addiction of young people, and there are problems such as school refusal in young people. In such a situation, a new field of gaming addiction emerges. In this virtual world, shopping will be with cryptocurrencies and bitcoins. Challenging experiences in life that need to be overcome, processes that take time and require patience, and the desire to get something quickly attract them the most. In addition to psychological problems such as addiction, there are the main problems to be encountered such as:

- Inability to cope with anxiety, difficulty in emotion management,
- Underdeveloped social communication and problem-solving skills,
- Different physical problems such as obesity, joint and muscle problems due to inactivity, and
- Real-life economic problems due to procrastination, neglect, and not exerting the necessary effort.

3. KEY CONCEPTUAL DEFINITIONS

VR is a technology that is still developing, as well as an increasing number of scientists from different fields, are working on it. Different definitions made by Stone (1991) and Oppenheim (1993) also summarize other definitions. According to Stone (1991), VR is multimedia that appeals to human senses, developed to increase communication between humans and machines. According to Oppenheim (1993), VR is a technology that tries to increase human-machine interaction through feeling, not contented with visual and auditory communication (Kurbanoğlu, 1996).

Imagination and reality have never been intertwined. For years, VR has been the "next big thing". Still, it has finally emerged to create stunningly realistic images, sounds, and other emotions amid an extraordinary fantasy world. Almost everyone has access to these fascinating technologies, but before pouring hard-earned money into a cutting-edge head-mounted display, let us take a closer look at what is needed for an amazing VR, AR, or MR experience. Technology has caught on, and market researchers have predicted rapid growth for the VR industry. Look-in toys were popular in the 1950s, and indoor flight simulators were first introduced in the 1960s, but the idea of VR goes even further. As early as the 1940s, inventors, science fiction writers, and fixers dreamed of an environment that could escape reality through art and machinery. VR can be used as a general term to describe similar but different technologies to the actual VR experience. The similarities and differences between VR, AR, and MR should be apparent (Intel, 2021).

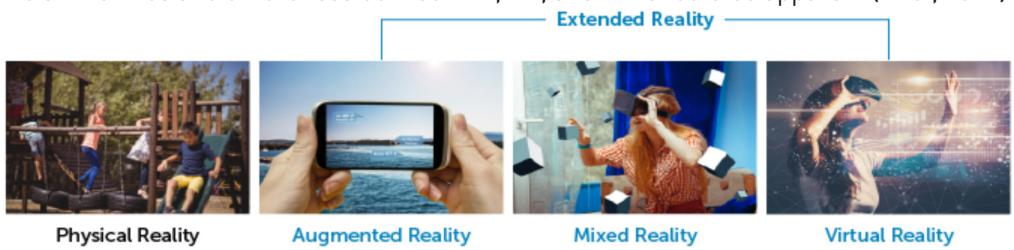

Figure 1. Different pictures for Physical, Augmented, Mixed and Virtual Realities

Source: (Siglin, 2018)

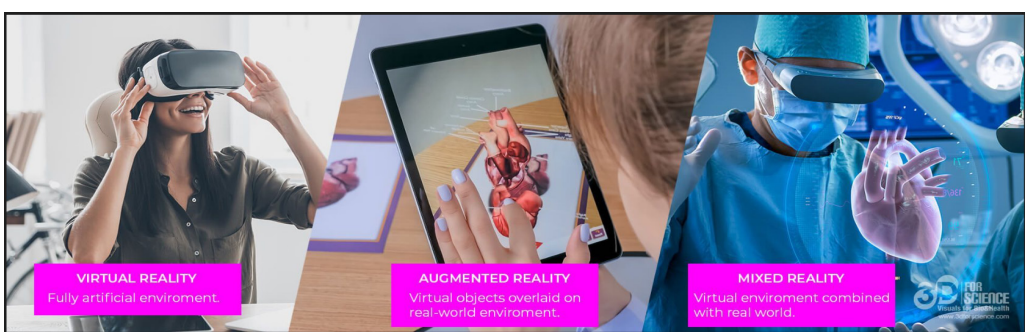

Figure 2. Different pictures for Augmented, Mixed and Virtual Realities
Source: (3Dforscience, 2020)

Virtual Reality
VR is the most widely known technology that is so gripping that it tricks senses into thinking in a different setting or a world apart from the real world. One can move or manipulate objects with touch controls while connected to the console or computer using a head-mounted display (HMD) or headset. One will experience a computer-generated world of video and sound.

Augmented Reality
AR places digital information on top of real-world elements. Pokémon GO* is one of the best-known examples. AR centers on the natural world but enriches it by layering it with other digital details, a new layer of perception, supporting one's reality or environment (Cem, 2020).

Mixed Reality

Using next generation sensing and imaging technologies in MR, one can interact with and manipulate physical and virtual elements and environments (Sen *et al.,* 2021). MR allows one to see the world he/she lives in and immerse in it, even if someone interacts with a virtual environment by using his hands without ever removing his headset. It breaks down the core concepts between reality and fantasy, delivering an experience that can change the way they play or work today (Holonext, 2019). There are head systems with different features developed by many commercial companies for the use of MR technology. The most known and used among these head systems are Microsoft HoloLens (Bray et al., 2018), Samsung HMD Odyssey (Carbotte, 2018), Lenovo Explorer (Carbotte, 2018; Borandağ & Yücalar, 2020).

VR Hardware VR systems enable users in the virtual world to interact physically with artificial warnings they direct. The interaction can be visual and auditory and through different senses such as tactile, smell, and taste. Specially designed gloves and clothes covering the whole body create these feelings. Above these, some sensors and stimuli allow the system to detect the user's movements and the warnings coming from the system. These stimulating systems are defined as "VR hardware"(Ferhat, 2016). Games to movies and medicine, VR, AR, and MR is becoming more and more common:

- **Games**—Over 2,000 games currently in use, from first-person shooter (FPS) games to strategy games and role-playing adventures
- **Health**—In education, such as in surgical simulations
- **Professional sports** —In training programs like STRIVR that assist professional and amateur athletes[1]
- **Film and TV**— Creating unique experiences in movies and shows
- **Virtual Travel**— Virtual trips to an art museum or another planet that one can take from home

1 For more information see: https://www.strivr.com/

4. SECURITY AND PRIVACY ISSUES AND KEY RISKS

One of the issues that people see as the most significant danger of AR is privacy is that AR collects much more information about who the user is and what they are doing than social media networks or other technologies. User privacy is at risk as AR technologies can see what the user is doing. This raises several concerns and questions (Kaspersky, 2021):

- How do AR companies use the information they collect from users and ensure security?
- If hackers manage to gain access to a device, the risk of loss of privacy is enormous.
- Do AR companies share this data with third parties? So, how do these companies use this data?
- Where do companies store their AR data? Locally on devices or in the cloud? Is data sent to the cloud encrypted?

Untrusted content

Advanced hackers can replace the user's AR with one of their own, misleading people or giving them false information. This brings reliability issues, as AR is a relatively new field, and authenticated content creation and delivery mechanisms are still being developed. Some cyberthreats can render content unreliable even if the source is genuine. These types of cyber threats include spoofing, eavesdropping, and data manipulation (Kaspersky, 2021).

Social engineering

Given the possible reliability of the content, AR systems can be an effective tool to deceive users as part of social engineering attacks. For example, hackers can distort users' perceptions of reality through false signs or screens, leading them to take action that will benefit hackers (Kaspersky, 2021).

Malware

AR hackers can insert malicious content into apps through advertising. Unaware users can compromise AR security by clicking ads that redirect to malicious websites or malware-infected AR servers that serve unreliable images.

Stealing network credentials

For merchants using AR and VR shopping apps, hacking can be a cyber threat. Criminals can steal network credentials from Android-powered wearables. Many customers› card information and mobile payment solutions are already registered in their user

profiles. Since mobile payment is a straightforward procedure, hackers can access and hijack these accounts.

Denial of service

Another possible AR security attack is a denial of service. In such a case, for example, users who rely on AR applications for their work may suddenly become disconnected from the information flow. For example, a surgeon may suddenly lose access to crucial real-time information from their AR glasses, or a driver whose AR-enabled windshield suddenly turns into a black screen may lose sight of the road (Kaspersky, 2021).

Hacking attacks between two ports

Network attackers can eavesdrop on the AR browser, AR provider, AR channel owners, and third-party servers. These types of attacks are called spying attacks between two ports.

Ransomware

Hackers can access a user's AR device and record their behavior and interactions in the AR environment. This can be embarrassing or unsettling for people who do not want their games and other AR interactions to be publicly known. By adding features designed explicitly to VR platforms, attackers can persuade users to give their personal information. As with AR, it creates a favorable environment for ransomware attacks.

Fake IDs or "deepfakes"

Machine learning technologies make it possible to manipulate audio and video to look like original footage. Since it is possible to access motion tracking data from a VR headset, a hacker could use this data to create a digital copy (also known as a " deepfake ") and aim to circumvent VR security for this purpose. It may be possible to embed it in someone else›s VR experience to perform a social engineering attack then. Other problems with VR that critics have identified as negative aspects of VR include (Kaspersky, 2021):

- Health effects include dizziness, nausea, or lack of spatial awareness.
- The potential for excess.
- Loss of connection with people.

5. VR APPLICATIONS IN EDUCATION

Although VR is an expensive technology, it is used in many fields for educational purposes, albeit limited. It is also possible to test factors such as color, lighting, and ergonomics beforehand. Students can do the work they want on cadavers created in virtual environments, or they can make a journey to the human body. Again, it can be used effectively for training students in foreign language education. A student who wants to learn a foreign language can live in that country by traveling to the country where they want to learn it through virtual education (Kayabaşı, 2005).

There is growing evidence that simulation in teaching is necessary to improve learning, skills, and outcomes, efficient skills. In the health sciences, high-fidelity task trainers are ideal for reducing cognitive load and enhancing learning outcomes (Birt *et al.,* 2017). It is expected to be widely used in academic and business education fields. For example, some parts of the training program developed by Microsoft and Japanese Airlines were introduced to the whole world in July 2016. It shows how an airplane jet engine comes in front of the user with hologram images and how the user enlarges, reduces, or rotates this image in the desired directions by using his fingers as a mouse. People using the headgear above can also verbally intervene in the virtual images before them. E.g., the MR system reacts very quickly to the command to show the ventilation and cooling system of the jet engine and can instantly bring the desired design. There is no need to go to the hangar where that massive jet engine is located to receive this training. In addition, they do not divide those jet engines, which are very expensive, into parts for educational purposes and present them to the students' examinations. MR technology overcomes all these difficulties. Simulations such as all kinds of laboratory tests and examinations in the battlefields in history lessons will attract the students' attention, reduce the learning time and make learning easier (Özdemir and Öztürk, 2022).

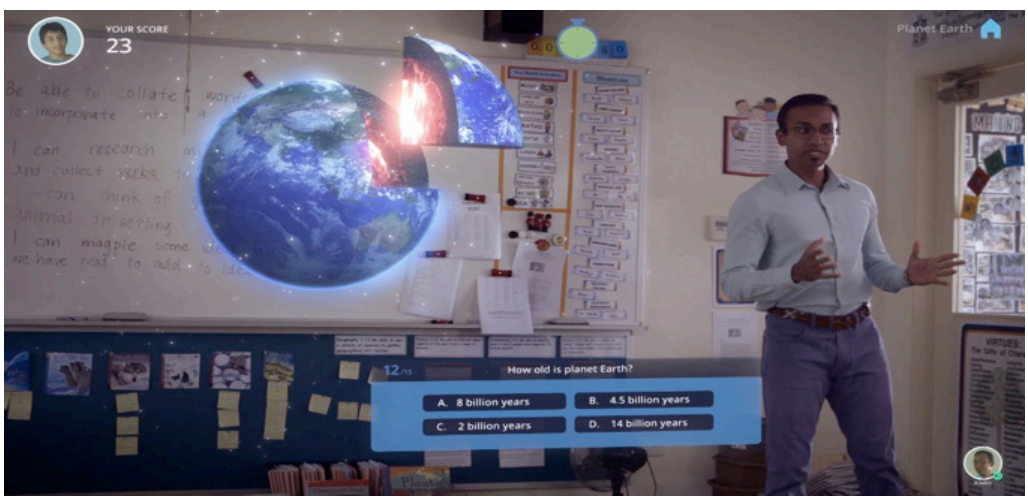

Figure 3. Augmented reality in education
Kaynak: (Cem, 2021)

6. MEDICAL EDUCATION AND PRACTICE

A versatile MR educational environment is a ubiquitous approach to highly impactful, low cost, high reusability gamified educational approach. Using prolific technologies such as inexpensive AR headsets and a versatile, low maintenance Database (DB) back ends, a natural world environment can be transformed with 3d graphics and audio to various educational spaces of highly impactful content (Antoniou *et al.,* 2016). Indeed, the applications to be used in medicine will significantly increase the quality of education. The failure rate of doctors who can see all the organs of their patients with hologram [2]copies, diagnose them with the help of artificial intelligence, produce organs with new generation printers and transplant them will decrease to almost zero.

Despite some hardware and technical deficiencies, VR technologies are used to treat many diseases and conditions with programs and interfaces; It is used as an assessment tool to detect heart rate variability and the initial stages of Alzheimer's. At the same time, patients can check their health status at home without going to the hospital by connecting with smartphone applications. The use of VR technologies and other mobile health technologies will increase the functionality of VR technologies and provide important developments in health services (Wiederhold, 2016). As VR technologies decrease production costs and become tools that everyone can use through simple interfaces in terms of use, they will be used more in the education of medicine and other health professions. In this way, students will have an education system to learn the procedures and other vital elements of treating patients in a virtual world or through simulators. As a result, since they can acquire specific skills safely, they will demonstrate their skills when they meet with patients (Reznek, Harter & Krummel, 2002). These technologies, which are used in surgery, treatment, rehabilitation, and education in health services, also benefit from other developments in technology and provide convenience to patients and healthcare professionals in doing their jobs (Demirci, 2018).

7. DESIGN PRACTICES

Interaction in a VR environment is the most natural interaction type, and the participants were eager to use both MR and VR environments instead of an emulator (Ergün *et al.,* 2019). The most crucial feature that distinguishes MR applications from AR is the interaction of users with virtual images. Those in different places can see the product under development through their titles and provide and see the changes in real-time with the instructions they will give to the people who manage the project. Alternatively, imagine that the officials of an architectural office evaluate a project drawn with hologram technology with colleagues remotely from different parts of the world. While his Japanese colleague requested the elevator be relocated, the architect in America might want the balconies to be slightly more prominent. Such changes can be made

2 For more information see: https://www.microsoft.com/tr-tr/hololens/hardware

instantly so that everyone can see them in 3D. All kinds of products can be produced error-free and optimal using similar applications during the development phase.

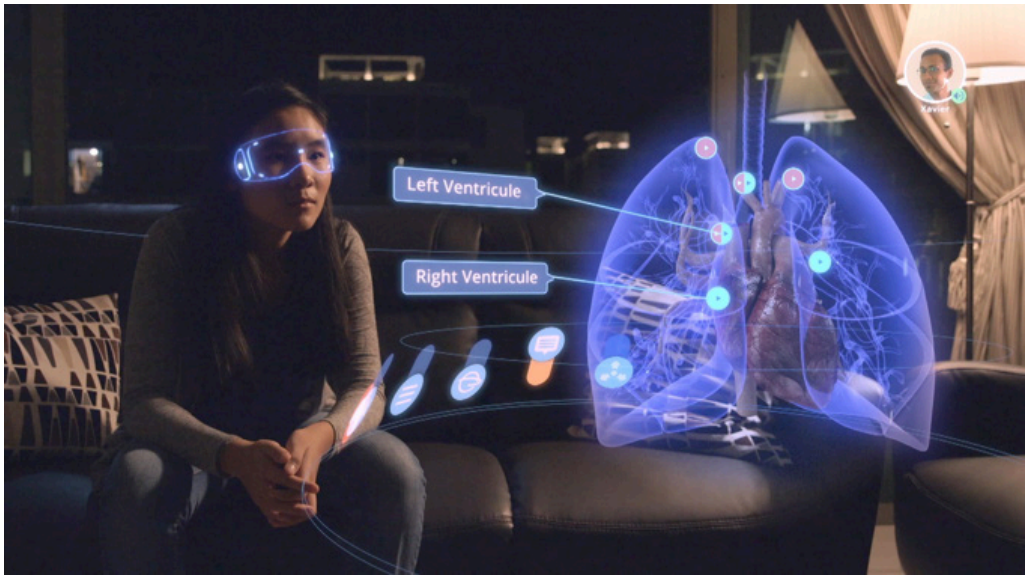

Figure 4. Augmented Reality in Medical Trainings
Kaynak: (Cem, 2021)

8. ENTERTAINMENT APPS

VR glasses do not yet have good ergonomics for the physical comfort of the users. Especially VR glasses, in which mobile phones are used, are heavy. However, glasses that use their screens will become much smaller and lighter by time. Studies on this subject continue VR glasses in regular glasses or contact lenses. These glasses or contact lenses can be considered a technological revolution. They make it easier to watch all other digital media products such as television, books, newspapers, movies, and advertisements anytime and anywhere. It will not take long for the movie industry to adapt to VR technology. Thanks to this technology, movies with 360° images to be shot and other factors designed will allow the VR phenomenon to spread to the world quickly. Currently, the scientific world is discussing the development of VR technologies with their positive aspects and some adverse social and psychological side effects. VR will pose a significant danger to some as a mind control method in the future. The adverse effects of the event's moral dimension have divided sociologists, psychologists, and even clergy into two. The products of companies that produce sexual content for adults also cause private life and family concepts to be questioned (Ferhat, 2016).

The quality of AI (i.e., speech recognition and synthesis via machine learning) associated with an augmented object increases MR immersion associated with spatial immersion, MR enjoyment, and consumers' perceptions of novel experiences (Sung *et al.,* 2021). Digital technologies used to entertain people have now gone far beyond gaming applications. The sense of fun and excitement provided by games played with VR or AR headsets/glasses used until recently has been taken to new dimensions. One can watch a concert of a favorite singer, a theater performance, or a sports event from own location in three dimensions with holographic images. Now, instead of going to entertainment venues, entertainment will come to the home.

Digital cinema technology is closely related to the development of computer games. For example, some games such as Tomb Raider, Assassins Creed, Mortal Kombat, which were liked by the masses, were shot as feature films. Likewise, computer games also benefit from cinema in terms of visual effects, framing techniques, and story design. Digital technologies give a new direction to the search for reality in cinema. Amateur video shoots, movies, and movie screenings in which the audience can be included in the process show the need for a new definition of reality. The fact that the platforms, especially Youtube, where amateurs can share their designs, appeal to the audience on a massive scale, shows that movie-watching habits have also changed. Shortly, it is predicted that artificial intelligence will play an active role in all filmmaking processes. We are very close to watching the films in which the scenario will be created by artificial intelligence according to the audience's desire, and the visual and sound effects are presented as options. Even computer games produced by artificial intelligence control the user's experience process. 21st-century cinema has significant advantages in creating and publishing virtual worlds/characters. Many intermediaries of the sector, especially the monopolies of distribution companies, will be adversely affected by this situation. However, new business areas and needed new professions (with high technology skills) will emerge (Barbaros, 2020).

VR sex is a new sex kind. Technological innovations in sex define our future generations and change how we express intimacy and love and how we see and relate to ourselves and others. (Alexandrovich and Gomes, 2020). It allows the user to get tactile sensations or fictional characters from distant participants using computer-controlled sex toys. (Kiiro, 2020). Usually, the user also wears a VR headset to see and interact with the partner (Varina, 2021). So, this type of AI based MR is ostensively fantastic but, can also severely harm human reproduction, social, psychological and spiritual structures and humanistic values.

9. MILITARY TRAINING

Advances in technology paved the way for war simulations in military personnel training. These trainings are not limited to only attack and defense issues. All the training required by military personnel can now be given through these technologies (Rathnayake, 2018). The most popular of these games were war games. Many of these games were developed under the supervision and supervision of military personnel (Cem, 2021).

Aviation

Digital technologies can also be used in the aviation industry, which requires care. AR, VR, and MR technologies can be used in aircraft design to performance evaluation and production line. Today, Airbus uses VR technologies to show aircraft to customers. The European Space Agency (ESA), on the other hand, uses AR technologies in maintenance and plans to use MR and AR technologies in the training of Mars flight personnel.

Tourism

VR technologies provide unique opportunities, especially for holiday lovers. With VR glasses, one can visit virtually any city in the country you want and visit the streets and museums. Today, some tourism companies also allow wandering around the region with VR glasses to explore holiday destinations. On the other hand, AR-based smartphones can guide you by recognizing the objects around you during your vacation (Avzal, *et al.,* 2022).

Industry

In addition to entertainment, these applications also come to the fore with increasing performance and increasing operational efficiency, especially in the industry. Display technologies, which make it easy to access relevant data, enable people and other devices to use resources better. It also reduces the time required, cost, and potential errors. Today, Ford and Audi VR use AR technologies to test different parameters to find the most suitable and efficient products.

Partnerships

AR and MR-based devices also support collaboration. Architects, engineers, and designers can quickly try different parameters with these technologies and see the results. Therefore, reality technologies are expected to break new ground in projects that require teamwork.

Installation and Maintenance

AR is becoming a tool that simplifies the most complex tasks for maintenance and installers. Broken or broken parts can be determined and repaired with the information

displayed on the screen for the device held where the operation is performed. It is sufficient for technicians to use head apparatus or tablet for this process. AR guidance can also be used under challenging assemblies in the production area.

Marketing

AR and MR technologies also play an essential role in promoting products to customers. A vehicle dealer or a clothing store can easily use these devices to try different products and colors. As a result, VR, AR, and MR technologies will change lifestyles soon. These technologies will be used in the areas mentioned above and many new areas, so a future you cannot even imagine will be waiting for us. Maybe humanity will completely escape from reality and shelter in the virtual world.

Remote work in business

Collaborative MR technologies enable remote people to work together by sharing communication cues intrinsic to face-to-face conversations, such as eye gaze and hand gestures (Yang *et al., (2020)*. The shared space typically consists of a video capture of the remote workspace displayed on a 2D screen (Huang *et al.,* 2018). Vocational training is frequently held for recruits and existing personnel in medium and large companies. In previous generation technologies, the activity was made available as pre-recorded images, and the user could not ask questions at the time of use. This training can now be done in real-time and interactively between the parties with hologram images. Employees who complete a five-minute training session with such a MR program are said to achieve the same level of success as reading a 50-page training manual. The said technology can be used efficiently in all areas of the business world, from paperwork at the desk to the maintenance and repair of production vehicles, from production planning to logistics and shipping. Of course, the usage area of Mixed Facts is not limited to the examples I have listed above. We will undoubtedly start to use these new digital technologies and applications in all areas of our lives shortly (within a few years) (Cem, 2021).

10. DISCUSSION ON METAVERSE

The definition of Metaverse is "offering a new reality, the world of meaning and collaboration opportunities; providing infrastructure and interaction opportunities for cultural, intellectual and economic production; different advanced technologies are used simultaneously and in an integrated manner; cyber social plane" (Kuş, 2021). Most people describe Metaverse as the next stage of the internet. It entered this virtual universe with virtual and AR devices alongside a personal computer, thus having the opportunity to experience other people or virtual objects directly with the five senses. (Doko, 2021). Although the epidemic process we are experiencing has increased its popularity with Facebook's conversion of the company name to "Meta" and announcing its investments in Metaverse, Metaverse is not a new concept. Despite its popularity, it is

not possible to make a clear definition of what Metaverse is and what it covers. Metaverse seamlessly integrates the real world with the virtual world and allows avatars to carry out rich activities, including creation, display, entertainment, social networking, and trading (Yang et al., 2022). With the "Metaverse" and the Cyber World Order, which is planned to be implemented in 2023, gas, electricity, and power plants and distribution centers, banks, government offices, population, and land registry records may be exposed to cyber-attacks and chaos may occur with "Cyber Terrorism." Everything is being prepared for the "Metaverse," and the products are registered with Blockchain (Aydin, 2021).

Most of the expectations about the Metaverse consist of technologies that we can experience today, but some of them have not yet been massified. In the world of "Second Life", where users create an avatar for themselves and live an alternative virtual life, it is possible to go to school, start a business, earn income, socialize with people, and invest. It is even possible to earn money through Second Life and transfer it to real life.

Metaverse's persistence and interoperability will provide users with more excellent continuity of identity and experience compared to the modern internet. In Metaverse, users will not need separate Twitter profiles, "Fortnite" characters, and Reddit accounts. They will be themselves on all channels. This continuity of identity will be the critical factor behind how users buy and consume content on the Metaverse. There are still quite a few obstacles to a true Metaverse. The biggest hurdles are also hardware limitations. Still, less than 20 percent of Americans are familiar with VR headsets, according to a 2020 report by Thrive Analytics and ARtillery Intelligence. Also, experts predict that devices like VR and AR have a chance to surpass game consoles by 2025 at the earliest. If the hardware and energy technology are sufficient, extensive cultural changes will be necessary to foster an actual Metaverse development.

Many Metaverse projects are still in their infancy. Again, augmented, and virtual reality technologies, or AR, still have a long way to go. In addition to their technological development, they also need to be cheap and mass-produced. It is not new for applications to create their economies in the virtual world. It is possible to watch a concert or a football match while wearing VR glasses and to watch the area where your eyes focus, not the camera, in the 360-degree virtual universe - unlike watching it on a computer and television. Again, online training or meetings can be held in the virtual reality universe. Wearable technology has also come a long way in recent years. With the increasing internet speeds, the internet of things (IoT) is entering our lives more and more every day. With smart homes and innovative city applications, objects can communicate and perform their predetermined tasks without human intervention. With AR applications, it is also possible to buy the shoes you like on phone by first holding the phone's camera on your feet, trying them on your feet, and seeing how they look. Among

all these technologies, how Blockchain technology (other than payment systems) will take place in the Metaverse is critical for the future of this virtual universe. Blockchain technology allows database creation without the need for any centralized structure. Will our identities on the Metaverse be kept in a decentralized environment or in the central databases of the technology giants involved in the process, with much more personal data than we produce today, including the data of our moods that we are afraid to admit even to ourselves? In either case, how will nation-states approach this situation? What will be the position of nation-states in these virtual universes? Questions like these remain unclear.

Most of the expectations about the Metaverse consist of technologies that we can experience today, but some of them have not yet been massified. In the world of "Second Life", where users create an avatar for themselves and live an alternative virtual life, it is possible to go to school, start a business, earn income, socialize with people, and invest. It is even possible to earn money through Second Life and transfer it to real life. However, with the current Deep Fake and voice cloning techniques, it is possible to produce a video of someone who does not exist to make someone say things they have never said. This audio-video combination is exceptionally close to reality. Imagine that you encounter this in a 360-degree virtual reality universe, and you can even experience the feeling of touch with the help of a special glove in your hand. Even today, it is getting harder to understand what is real and what is virtual, and this will be a much more significant challenge. Apart from many start-ups and entrepreneurs working on the Metaverse, the Largest Projects are those:

Decentraland

Technology giant Samsung has moved its famous Samsung 837 store in New York to Decentraland. One of the largest metaverse universes with 90,601 parcels allows users to build whatever they want. MANA is the cryptocurrency of this universe powered by the Ethereum blockchain. MANA gained 15 percent after Samsung announced that it had entered Decentraland *(www.decentraland.org)*.

The Sandbox

The Sandbox (SAND) project, a critical metaverse coin, has recently been a favorite of investors. Sandbox is a gaming metaverse created by Pixowl company in 2011, and the cryptocurrency SAND was built on the Ethereum blockchain. The Sandbox also announced last month that it is collaborating with Adidas. American rapper Snoop Dogg has started building a virtual mansion here *(www.sandboxgame.com)*.

mOVR

It is a Metaverse platform with Ethereum blockchain-based AR and VR experiences. It is possible to buy plots worldwide through OVR, which combines the real and virtual worlds

with AR. With OVR, one can experience the Metaverse, meet new people in OVR rooms, and attend NFT exhibitions in galleries. Two hundred thousand parcels were sold from Turkey, and more than 11 thousand of these parcels are from Istanbul. Many Metaverse projects are still in their infancy. Again, augmented, and virtual reality technologies, or AR (XR), still have a long way to go. In addition to their technological development, they also need to be cheap and mass-produced *(www.ovr.ai)*.

11. CONCLUSION

Many IT based devices such as televisions, smart mobile phones, ovens, refrigerators work with computer systems. It has become commonplace to benefit from many computers such as the military, architecture, education, and advertising. With the development of technology, computers that used to make only electronic data transfer and complex calculations can solve problems that cannot be solved mathematically, summarize large amounts of data by filtering, comment on events and even learn independently. In other words, computers can both make decisions by collecting information about events and learn the relationships between events by interpreting them.

Although the MR technology, which brings together the virtual and real-world, continues its active development, especially in education and health, it has made itself known with applications in health. Still, it is also used in the military, automotive, marketing, etc. It is a technology suitable for use in many areas. However, it is possible to see different application examples in many fields, from medical education to diagnosis and treatment processes of this technology, which has made a name for itself with its studies in health. Imaging technologies such as MR, which continue to develop and progress rapidly, are based on the ability to operate related processes independently of time, place, and people in many subjects or to execute them remotely. Creating virtual worlds that could only be imagined in the past and overlapping the virtual and real worlds is now possible with augmented, virtual, and MR. In this study, we examined the applications in the field of health, which is an applied field that can make maximum use of the possibilities offered by MR. Especially in medical education, its use for diagnosing and treating diseases will become widespread. HAVELSAN, which has become a world brand in simulation technologies and has original software-oriented solutions and products, acts with the vision of being the national and international leading system integrator in its field. In this context, As HAVELSAN realized, the Hapsim simulator, which is based on MR technology, is one of the new generation technologies since simulation technology is its main field of activity and includes various disciplines. Likewise, it continues to develop different solutions by following the developments in the MR field (Dogan et al., 2021).

Many companies today use MR for production and research. Companies may distribute equipment for MR to their users and enable them to create their digital environments. While screen and media addiction are the subjects of scientific research and congresses,

scientists are investigating how children and young people, who are called "netizens" or "digital citizens", will be affected by new technologies. It is thought that the effects of virtual reality on children and young people will be more intense than on adults. It is predicted that new technologies will cause physical discomfort, especially in the head, eye, and neck region of children and young people who are in the age of development physically and cognitively, and even damage their brains. In addition, the infrastructure of controlling the minds of children and young people by hypnotizing them by governments, capital owners, and other power centers seems possible with this new technology. Government regulative bodies, as a public service broadcaster and a major media producer, should take the necessary steps to guide society to the technologies of the future in a healthy way, with the responsibility required by public service broadcasting in the face of these developments in the world and Turkey. It should be a pioneer in the sector by providing R&D support to qualified virtual reality studies in education and entertainment and producing educational content. Together with TRT, RTÜK and other relevant public institutions should prepare the infrastructure for legal regulations regarding this new technology and new content. Establishing an upper advisory board and an ethics committee in this area would also be beneficial. The developing virtual reality world also creates new professions. Universities' software, design, fine arts departments, and educational institutions need to create a specialized training program for these emerging professions.

The Metaverse is an important vision for the new era of the internet. There appears to be a few misperceptions in this area for three reasons:

- The first is that Facebook's Meta launch is supposed to start from today to tomorrow. There is no possibility that it will not materialize at the level of expectations and return to a bubble. However, the glasses technology and processor speeds must reach the desired level; five years at best and ten years.
- Second, it is perceived as a single Metaverse universe and is the subject of plot speculation. However, there is no reason why there should not be thousands of Metaverse universes in the future.
- Third, although it is reduced to it today, it is not just a vision tied to VR glasses. Metaverse is something that we have entered since 2003's Second Life game. Games like Roblox, Fortnite, World of Warcraft always occur in the Metaverse.

While having fun in this virtual world, we will also be with one foot. It is a beautiful version of fantasy and science fiction, but how are we supposed to use it for the benefit of humanity? The purpose of life is not just to live, eat, drink, reproduce. Then we become the same as primitive creatures. The goal of separation is to think about death, reality after death, life. Only worldly thinking cannot make a person happy. Metaverse cannot serve human happiness.

Metaverse inherently transforms into personal, biometric, financial, and even emotional data, raising security, privacy, and intellectual property concerns. Likewise, when avatars are used as a form of identity, personal data becomes vulnerable to being copied, stolen, deleted, or manipulated. Although biometric identification is a solution, it should not be forgotten that identity fraud is always a significant risk, and necessary measures should be started now. At a personal level, there should be some reasonable precautions against VR and AR risks and threats:

- *Reviewing privacy and data confidentiality policies and procedures:* Sometimes, it is easy to bypass lengthy data privacy policies or terms and conditions.
- *Avoiding revealing very personally private information:* Do not disclose personal information that does not need to be disclosed.
- *Using a VPN tunnelling:* One of the ways to keep identity and data privacy on the internet is to use a VPN service.
- *Being active in the real world:* VR is not the reality itself; it will remain virtual.
- *Sticking humanistic, religious and cultural values to protect humanity.*
- *Keeping firmware up to date:* Keep updated for VR headsets and AR wearables. Updates help fix security flaws and add new features and improve existing ones.
- *Using comprehensive antivirus software:* The best way to stay safe online is to use antivirus software to capture viruses, ransomware, malware, phishing, spyware, and other emerging internet security threats.

When we as our research question *"Will VR, AR and MR innovative technology lead to interaction with spirit realms, jinn and angels when supported by super AI*?", with the limits of literature knowledge it is found no answers yet. VR, AR and MR applications aim to overcome the limitations of the physical environment in theory and can provide instant interaction with other physical environments at the speed of light. Unbelievably rapid developments in the innovative dimension of scientific applications do not yet provide definitive evidence on whether this will enable spiritual interaction or whether it will enable communication with angels, demons and spirits of dead people though it is still on the enhancement of physical interaction and made-up virtual artefacts. It is assumed that if such an opportunity and functionality is obtained, religious perceptions, faith and worship may be adversely affected. But this area should be studied with a multidisciplinary approach by theologians, psychologists, spiritualists, and philosophy branches.

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REFERENCES

Ağralı, Ö. ve Aydın, Ö. (2021). "Tweet Classification and Sentiment Analysis on Metaverse Related Messages", Journal of Metaverse, 1(1), s.25-30.

Aleksandrovich, A. & Gomes, L. (2020). Shared multisensory sexual arousal in virtual reality (VR) environments. Paladyn, Journal of Behavioral Robotics, 11(1), 379-389. https://doi.org/10.1515/pjbr-2020-0018

Antoniou P. E., Dafli E., Arfaras G. and Bamidis P. D., (2016) "Versatile Mixed Reality Educational Spaces - A Medical Education Implementation Case," 15th International Conference on Ubiquitous Computing and Communications and 2016 International Symposium on Cyberspace and Security (IUCC-CSS), 2016, pp. 132-137, DOI: 10.1109/IUCC-CSS.2016.026.

Aydin, İ. H. (2021) Metaverse ve Sonrası, Luminosophy, https://www.acapublishing.com/dosyalar/baski/LUMINOSOPHY_2021_566.pdf

Avzal, A., Özdemir, D., & Erarslan, K. (2022). Aizanoi Antik Kentinin Artırılmış ve Sanal Gerçeklik Teknolojileri Kullanılarak Turistik Amaçlı Tanıtım Uygulamala Örneklerinin Tasarımı. Eskişehir Türk Dünyası Uygulama ve Araştırma Merkezi Bilişim Dergisi, 3(2), 66-73.

Barbaros, I. (2020) Sinema ve Sanal Gerçekliğin Ortak Geleceği Üzerine Bir Değerlendirme, Yaşar Üniversitesi Master Tezi

Birt, J., Moore, E., & Cowling, M. (2017). Improving paramedic distance education through mobile mixed reality simulation. Australasian Journal of Educational Technology, 33(6). https://doi.org/10.14742/ajet.3596

Borandag, E. & Yücalar, F. (2020). Arttirilmiş gerçeklik ile scrum task board uygulaması. Uluslararası Yönetim Bilişim Sistemleri ve Bilgisayar Bilimleri Dergisi, 4 (1), 1-12. DOI: 10.33461/uybisbbd.652366

Bray B., Mcculloch J., Schonning N., Zeller M. (2018). What is mixed reality?. https://docs.microsoft.com/en-us/windows/mixed-reality/mixed-reality

Burdea, G. ve Coiffet P.(1994). Virtual Reality Technology. Paris: Wiley-Interscience, Hermes.

Carbotte K. (2018). Lenovo Explorer Windows Mixed Reality Headset Review: A Low-Cost VR OnRamp. https://www.tomshardware.com/reviews/lenovo-explorer-windows-mixed-realityvr,5468.html.

Cem H. (2021) Karma Gerçeklik, Haber24, https://t24.com.tr/yazarlar/hayri-cem-haftalik/karma-gerceklik,29959

Cem Hayri, (2020) Augmented Reality, T24, June 30, URL: https://t24.com.tr/yazarlar/hayri-cem-haftalik/artirilmis-gerceklik,27213

Damar, M. (2021). "Metaverse Shape of Your Life for Future: A Bibliometric Snapshot", Journal of Metaverse, 1(1), s.1-8.

Demirci Ş. (2018) Sağlık Hizmetlerinde Sanal Gerçeklik Teknolojileri, nönü Üniversitesi Sağlık Hizmetleri Meslek Yüksekokulu Dergisi, ISSN: 2147-7892, Cilt 6, Sayı 1(2018) 35-46

Doko, E. (2021). Alternatif bir dünya arayışı: Metaverse. Lacivert, 85, 79-81.

Ergün O., Akın Ş., Dino İ. G. and Surer E., (2019) "Architectural Design in Virtual Reality and Mixed Reality Environments: A Comparative Analysis," IEEE Conference on Virtual Reality and 3D User Interfaces (VR), 2019, pp. 914-915, doi: 10.1109/VR.2019.8798180.

Ferhat S. (2016) Dijital Dünyanın Gerçekliği, Gerçek Dünyanın Sanallığı Bir Dijital Medya Ürünü Olarak Sanal Gerçeklik, TRT Akademi ISSN 2149-9446 Cilt 01 Sayı 02 Temmuz Dijital Medya Sayısı

Frenkel S., Browning K., (2021) The Metaverse's Dark Side: Here Come Harassment and Assaults, NYTIMES, https://www.nytimes.com/2021/12/30/technology/metaverse-harassment-assaults.html

Grau, O. (2003). Virtual Art: From Illusion to Immersion. Cambridge: MIT Press.

Holonext, Admin, (2019) What is Mixed Reality? 02.01. 2019, URL: https://holonext.com/karma-gercelik-nedir/

Huang, W., Alem, L., Tecchia, F. et al. Augmented 3D hands: a gesture-based mixed reality system for distributed collaboration. J Multimodal User Interfaces 12, 77–89 (2018). https://doi.org/10.1007/s12193-017-0250-2

Intel (2021) Comparison between VR, AR and MR: What do you need to know?, https://www.intel.es/content/www/es/es/tech-tips-and-tricks/virtual-reality-vs-augmented-reality.html

İpek, A.R. (2020) Naming And Identification Problems At Augmented Reality, Virtual Reality And Mixed Reality, IDIL, s. 1061–1072. https://doi.org/10.7816/idil-09-71-0

Kalkan, N. (2021). "Metaverse Evreninde Sporun Bugünü ve Geleceğine Yönelik Bir Derleme", Ulusal Spor Bilimleri Dergisi, 5(2), s.163-174

Kaspersky (2021) What are the Security and Privacy Risks of VR and AR, https://me-en.kaspersky.com/resource-center/threats/security-and-privacy-risks-of-ar-and-vr

Kayabaşı, Y. (2005) Sanal Gerçeklik Ve Eğitim Amaçli Kullanilmasi, The Turkish Online Journal of Educational Technology – TOJET July 2005 ISSN: 1303-6521 volume 4 Issue 3

Kiiro (2020) Realistic, Interactive VR Sex Is Finally Here, and It's Affordable, Futurism, https://futurism.com/vr-sex-kiiroo-titan-headset-vibrating-stroker

Kurbanoğlu S. (1996) Sanal Gerçeklik: Gerçek Mi, Değil Mi?, Türk Kütüphaneciliği 10,1, 21-31, http://www.openaccess.hacettepe.edu.tr:8080/xmlui/bitstream/handle/11655/10496/1461-2921-1-PB.pdf?sequence=1&isAllowed=y

Kuş, O. (2021). Metaverse: 'Dijital Büyük Patlamada' Fırsatlar ve Endişelere Yönelik Algılar . Intermedia International E-journal, 8 (15) , 245-266 . DOI: 10.21645/intermedia.2021.109

Nalbant, K. G. & Uyanık, Ş. (2021). "Computer Vision in The Metaverse", Journal of Metaverse, 1(1), s.9-12.

Milgram, P. & Kishino, F. (1994). A Taxonomy of Mixed Reality Visual Displays. IEICE Transactions on Information Systems, Vol E77-,D, No.12, 1-15.

Oppenheim, Charles. (1993). "Virtual reality and the virtual library", Information Services and Use (13):215-227.

Özdemir, D., & Öztürk, F. (2022). The Investigation of Mobile Virtual Reality Application Instructional Content in Geography Education: Academic Achievement, Presence, and Student Interaction. International Journal of Human–Computer Interaction, 38 (16), 1487-1503, DOI: 10.1080/10447318.2022.2045070

Özkahveci, E.; Civek, F. & Ulusoy, G. (2022). "Endüstri 5.0 Döneminde Metaverse (Kurgusal Evren)'Ün Yeri", Journal of Social, Humanities and Administrative Sciences, 8(50):398-409.

Rathnayake W. G. R. M. P. S., (2018) "Usage of Mixed Reality for Military Simulations," International Conference on Current Trends towards Converging Technologies (ICCTCT), 2018, pp. 1-5, doi: 10.1109/ICCTCT.2018.8550993.

Reznek M, Harter P, Krummel T. (2002) Virtual Reality and Simulation: Training the Future Emergency Physician. Academic Emergency Medicine, 9(1): 78-87.

Scoble, R. & Israel, S. (2017). The Fourth Transformation: How Augmented Reality and Artificial Intelligence Change Everything. USA: Patrick Brewster Press.

Shen G., Dai J., Moustafa H. and Zhai L., (2021) "5G and Edge Computing Enabling Experience Delivery Network (XDN) for Immersive Media," *IEEE 22nd International Conference on High Performance Switching and Routing (HPSR)*, 2021, pp. 1-7, doi: 10.1109/HPSR52026.2021.9481809.

Siglin T. (2018) AR, MR, XR and VR Streaming: Understanding the 4 R's, WOWZA, https://www.wowza.com/blog/ar-mr-xr-and-vr-streaming-understanding-the-4-rs

Stone, Robert J. (1991). "Virtual reality and cyberspace: From science fiction to science fact", Information Services and Use (11): 283-300.

Sung Eunyoung (Christine), Sujin Bae, Dai-In Danny Han, Ohbyung Kwon, (2021). Consumer engagement via interactive artificial intelligence and mixed reality, International Journal of Information Management, Volume 60, 102382, ISSN 0268-40 12, https://doi.org/10.1016/j.ijinfomgt.2021.102382

Tang YM, Au KM, Yohana Leung, (2018) Comprehending products with mixed reality: Geometric relationships and creativity, International Journal of Engineering Business Management, https://doi.org/10.1177/1847979018809599

Varina R. (2021) I Cheated on My Husband by Fucking a Virtual Reality Porn Star, and I Want to Do It Again—IRL, Cosmopolitan, https://www.cosmopolitan.com/sex-love/a35843984/virtual-reality-sex-review/

Wiederhold BK. Lessons Learned as We Begin the Third Decade of Virtual Reality. Cyberpsychology, Behavior, and Social Networking, 2016; 19(10): 577-578.

Yang Qinglin, Zhao Yetong, Huang Huawei, Zheng Zibin (2022) Fusing Blockchain and AI with Metaverse: A Survey, Journal of Computer Science Computers and Society, https://arxiv.org/abs/2201.03201

Yang, J., Sasikumar, P., Bai, H. et al. (2020). The effects of spatial auditory and visual cues on mixed reality remote collaboration. J Multimodal User Interfaces 14, 337–352 https://doi.org/10.1007/s12193-020-00331-1

Yengin, D. ve Bayrak, T. (2017). Sanal Gerçeklik - VR. İstanbul: Der publications.

3dforscience (2020) Differences between VR, AR and MR, https://3dforscience.com/differences-between-vr-ar-and-mr/