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VR and AR technologies in contemporary cultural space

The article deals with the topics related to the application of virtual and augmented reality technologies in the sphere of culture and art. The essence characteristics of VR and AR-technologies are given. The essence of the concept of "immersiveness" is revealed. Techno-technological aspects of VR and AR technology in the modern cultural space are as well as cultural aspects. The main regularities and peculiarities of virtual and augmented reality technologies' interaction with the sectors of cultural space open both for immersive influence and for the use of one or another visualization technique — with cinematography, museum business, tourism, theatre, fine arts — were revealed. The factors determining the nature of mutual influence between culture and the latest technologies have been analyzed. Besides, the article presents a number of tasks performed with the use of immersive technologies and examples of their use in the "Arte-fact" program. The problematic points in the application of VR and AR technologies have been identified, concerning both socio-ethical and marketing factors. The conclusion is made that the use of the latest technologies in the cultural sphere contributes to overcoming the boundaries between the various sectors of creative activity, creates the prerequisites for transforming culture into a single information and semantic space.

Keywords: virtual and augmented reality technologies, cultural space, art, immersiveness, visualization.

Introduction

At the current stage of social development, the cultural sector is in active interaction with advanced information technology. The work of the majority of cultural institutions is based on an Event Strategy implemented with the help of internet channels and digital marketing. The media, internet, social networks, digitalization of information flows, and interactive advertising techniques are all transforming the cultural sphere into a single information space, a system of intra- and inter-branch communications subject to common rules.

The IT space combines communication and telecommunication services, electronic hardware and software production, creation of web services, consulting, etc. The rapid development of the IT industry is due to the increasing cultural level of the mass audience and the gradual growth of public demand for cultural products and services. Thanks to the IT infrastructure, people's sustained interest in creative innovation is sustained.

The interaction between the sphere of culture and the technological environment is natural: culture is the sum of all material and cultural values created by mankind, and technology is part of this sum as its most important component. The development of technology depends on, and is at the same time directly influenced by, the level of culture achieved at a given time. The technological environment is constantly expanding. More recently, it has been enriched by virtual and augmented reality technologies.

Experimental

The term "virtual reality" began to spread around the world in the mid-1980s [1], the term "augmented reality" in the early 1990s [2].

Virtual reality (VR) is a digital world synthesized and visualized by a computer [3]. The virtual reality (augmented reality, AR) is a three-dimensional system of combining the virtual and the real [4].

VR technology is a set of devices and procedures for their use that allow a person to be immersed in a virtual world, in an artificially shaped environment. The dominant technical means by which this task is accomplished are helmets and virtual reality glasses. Controlled computer simulation also uses virtual rooms, interactive booths, special VR consoles, sensory suits and gloves.

AR technologies refer to technical ways of supplementing real space with a virtual layer, which are provided by appropriate technical means — augmented reality glasses, 3D avatars, interactive monitors, pro-

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jectors that create holograms or overlay visualized objects, pictures, texts, diagrams on the screen in order to convey certain information or evoke certain emotions in users. The headsets used in AR technologies are constantly being improved. For example, in 2014, Google tested the GoogleGlass mini-computer embedded in the frame of AR glasses [5]. In 2016, Microsoft introduced the HoloLens, a model of so-called "smart glasses" [6].

AR occurs when sensory data is introduced into the user's visual field in order to supplement their information about their surroundings, to change their perception of their surroundings. AR is a mixed reality, a hybrid of VR and RR elements. In modeling augmented reality, elements of the present, objectively existing reality are sometimes removed [7].

The difference between virtual reality and augmented reality is captured quite clearly. It is only possible to enter VR with a special headset. VR "disconnects" the user from objective matter, "taking" them into a digital universe [8; 22]. Unlike VR, AR does not completely block objective reality, only adding elements of the digital system to it [4], [7]. Thus, virtual reality is a new artificial world; augmented reality is individual artificial details and links introduced into the perception of the present reality (PR).

The differences between VR and AR do not equal their lack of common characteristics. Both VR and AR mimic the human experience, but the human response to that experience is quite organic: the neurons of the human brain respond to virtual objects in the same way as they do to reality objects [9]. Both VR and AR interact with real time, and the objects included in virtual and augmented reality can "behave" both according to the real laws of physics and in defiance of them.

VR and AR technologies are sometimes referred to as "augmented reality technologies" [10]. This phrase refers to the full or partial presence of users in an alternative space and the associated change in their consciousness, emotional experience and baggage of impressions. By "living in" the virtual=environment, the exploiter begins to interact with the objects within it; the effect of presence emerges. From this point of view, VR and AR technologies can be interpreted as "presentation techniques" [11]. Despite its virtual nature, this "presentation" can have quite definite qualitative parameters, affecting the emotional and intellectual mood of the audience, evoking a variety of associations in them.

Results and Discussion

According to the universal logic of all development, ascending from simple forms and entities to more complex ones, VR and AR were initially "tested" in devices with entertainment and gaming functions. For example, in 1996, the AR media franchise Pokémon (Pocket Monster) was created and became popular in countries where the public had access to the purchase of a headset reproducing augmented reality [12; 400-401].

In part of the mass consciousness, virtual and augmented reality technologies are still associated with the entertainment industry, and the emergence of VR and AR content reflecting cultural and educational themes is often perceived as a continuation of trends entrenched in the entertainment business. However, it would not be quite right to draw simplistic parallels between the cultural sphere and leisure commerce. Culture and the arts have higher demands on the quality of content than showbiz, which is oriented towards reduced taste patterns.

One of the criteria for a creative act that differs from an entertainment event is immersiveness — the author's desire to create an effect of presence in the artistic reality he has created, to immerse the reader, viewer or listener in it, to influence their consciousness by "shaking" or changing it. Immersiveness has always existed in one form or another. For centuries, its depth has been a measure of the talent of literary, pictorial, musical and theatrical works, and has determined the extent of the public response they have generated.

Over time, immersiveness has changed its forms, methods and means of expression. The current stage of cultural development is characterized by an increase in immersiveness, with creators paying particular attention to new ideas, special effects, breakthrough techniques and technologies — anything that enhances the interaction between the creator and his audience, that can give the recipient a sense of involvement in the creative act. VR and AR technologies are at the forefront of innovation.

The current state of VR and AR technologies does not yet allow them to have an all-encompassing impact on cultural development. It is difficult to imagine their profound implementation in such cultural sectors as literature, librarianship, book publishing, translation, folklore, and musical art. However, in some cultural sectors products of which are compatible with volumetric visualization, virtual and augmented reality technologies are quite successful. This is the case, first and foremost, with cinema.

Virtual cinema has developed differently in different countries. VR filmmaking has made great strides in the United States. This is largely due to the long-established practice of combining directorial and production efforts there. It's no coincidence that, among the first films made in VR format, the films made by famous Hollywood figures resonated the most. In 2016, for example, Kathryn Bigelow released a VR documentary called The Protectors, which focused on current environmental issues. Two years later, director Robert Rodriguez made his mark with the action film The Limit, essentially the first action-packed VR film [13].

Before the exacerbation of the Covid-19 pandemic, virtual filmmaking was developing dynamically in France, where VR film makers enjoy state support. In 2019, a number of French VR films were included in the schedule of screenings at the world's largest film forum in Cannes. In 2020, about a dozen VR film projects were presented at the French documentary film festival in Biarritz. Unfortunately for connoisseurs of French VR cinema, its quantitative and qualitative growth has been negatively affected by the Covid-19 pandemic [14].

In the years leading up to the pandemic, filmmakers in Italy, Spain, Germany, Russia and China have developed their own VR productions. It should be noted that practically no VR project is without some elements of international cooperation. Suffice it to say that VR-helmets required for the creation of virtual reality are so far produced only on a licensing basis.

An important prerequisite for the promotion of VR cinema is the development of an appropriate infrastructure. It largely depends on the relationship between cinemas, distributors and audiences. This relationship proves to be quite stable when it comes to smaller venues and releases. Virtual cinema production is readily accepted by art house cinema chains such as AlamoDrafthouse in the US and YourScreen in the UK [15]. In the UK, where the creative industries are given special attention, the spread of VR cinema is facilitated by the attention to this issue from the state department of culture [16; 40].

In 2015–2016, screenings of virtual films and spots were included in regional or interregional film events held in Toronto, Geneva, Leipzig, Melbourne, Dubai, Minsk [17].

In June 2016, a virtual cinema festival was held in Moscow. It gave an extra boost to the development of VR cinema in Russia. In 2018, an immersive cinema called AtmaSphere 360 was opened in Moscow. Under the dome of the spherical screen, which surrounds the audience on all sides, they began to show movies in VR-format [18].

Virtual cinema is divided into interactive and panoramic films. Interactive films involve the direct participation of the viewer in the development of the plot by choosing from the options for the unfolding of events provided by the authors. An example of such cinema is the adventure film "Kessler Effect", made by the Russian director A. Utkin. Even some documentaries, such as Lake Baikal: The Spirit of Winter, have been produced in an interactive format. This film is marked by the presence of a bright author's style. The director G. Molodtsov used complex computer technology to shoot it [13].

Panoramic film production is a 360-degree view, a stereoscopic unfolding of all aspects of cinema. Despite their entertainment potential and appeal to moviegoers, panoramic films are still quantitatively inferior to interactive films. The situation will change when the budgets of panoramic projects are optimized.

The main advantage of virtual cinema compared to conventional films is in overcoming the barrier between the viewer and the screen, in the pronounced effect of immersing the viewer in the screen action, and in enhancing spectacle. However, VR cinema is in its infancy, so a lot of attention is being paid to dynamic genres such as action movies, sci-fi and horror movies, which contain a lot of mesmerizing attraction for the viewer. There is no harm in that: once silent, and then sound black and white cinema was nothing more than an entertainment attraction, which in order to become art, had to go a certain way. Virtual cinema should follow a similar path, with the passage of time mastering dramaturgy, comedy, historical themes and detective stories.

Virtual cinema is slowly but surely finding its own unique language and mastering the means of artistic expression that are available only to it. Three-dimensional reality and a 360-dimensional view allow a new approach to filming, the use of sound and light, film editing, and focusing the audience's attention. Here, "there is simply no frame that we are used to in traditional cinema" [13], here much depends on the professional skills of directors and cameramen, on their ability to influence the audience's attention from the first seconds of filming.

VR cinema, like the conventional 2D film industry, is an indivisible fusion of three elements: art, technology and business. To make this fusion balanced and harmonious is not easy task, because VR technology

is still taking its first steps, the search for the means of expression in the creation of VR films is far from over, and producers are forced to experiment with schemes and methods of distribution of VR products.

In order to effectively reach audiences, VR filmmakers have to take care of both content quality and technical innovations, working with engineering services to commission them to design new stereoscopic cameras, accessories and headsets. The directors and operators of virtual cinema have had to spend a lot of time experimenting with technical optics, selecting lenses of various formats, and matching them with their cameras. This work is aimed not only at ensuring the high quality of VR images, but also their unconditional compatibility with the formats of the helmets and platforms where they will be shown. The success of VR film projects can only be achieved through the coordinated interaction of creative teams, which, in addition to producers, directors, cameramen, editors, designers, and sound directors, must include specialists in 3D-graphics and interactive technology.

An important prerequisite for a successful VR film project is a well-designed creative and technical plan. This plan includes, among other things, post-production activities, which are already scheduled at the scriptwriting stage. Successful promotion of VR film projects is impossible without interaction with sponsors. These sponsors are venture and specialized funds, state, regional or private organizations interested in promoting or testing certain programmes, ideas and brands. Some funds can be received from manufacturers of VR-helmets, from people who own cinema chains. Crowdfunding is not uncommon. An encouraging factor for VR filmmaking collectives has been the emergence of special programmes for the development of virtual reality technologies — "Oculus VR for Good" and "Vive Arts" [13].

It is worth noting that a large number of VR documentaries contain a geographical, tourist component. Their authors are aware that a significant part of today's audience is not interested in documentaries in and of themselves, but in travel, tourism and the natural, landscape and climatic diversity of the planet. Often such spots are commissioned by TV channels, which have a stable place in their broadcasting schedules for travel programmes.

Many VR video projects dedicated to virtual excursions have marketing overtones. Often, the creation of virtual models of various tourist sites is initiated by administrative, transport and infrastructure, cultural and sports authorities. An illustrative example is the project "Virtual Sochi" implemented in 2014 by the Russian company NextSpace, one of the leaders in the field of software and interactive visualization. This project was commissioned by the Organizing Committee for the Winter Olympic Games in Sochi. More than 10,000 buildings and structures, including all key sports, road infrastructure, and social facilities were entered into the virtual space [19; 103].

Back in 2010–2012, augmented reality applications appeared on the consumer market in a number of countries, making it possible to view the sights of Tuscany, London, Basel and other places of interest online. At the same time, an AR project called Archaeoguide was created with the participation of Greek archaeologists to act as a personal tour guide for visitors to cultural and historical sites in Europe. The app includes data on interesting archaeological sites, historical information, etc. [20; 110]. In 2016, the Russian studio "AR Production" created an augmented reality navigator for Cyprus [21; 194].

There are now quite a few virtual guides created on the basis of high-quality 360-degree photos and videos and included in the structure of information portals of various cities, regions and countries. Today, it is not difficult to find specialized websites that function as virtual reality guides. With their help, anyone can, without leaving the walls of their flat, take a virtual trip to almost any country in the world. During the period of preventive restrictions against Covid-19, the importance of such guides increases considerably.

Virtual guides are also useful for those planning a real trip to popular tourist destinations. When preparing for a trip, a potential voyager can use information and technology to test the hospitality potential of future destinations in advance, assessing the strengths and weaknesses of hotels, retail establishments, catering establishments, infrastructure, and transport. According to one researcher, "the demonstration of the final tour product helps the tourist to form his attitude to the purchase and, if he has formed positive associations, encourages him to buy the tour" [22].

The advantages of VR tourism are not only access to remote viewing of tourist attractions, but also the opportunity to learn about the history and culture of particular countries, regions and cities, to find out what the places of interest looked like in previous centuries and the way of life of the inhabitants.

Virtual tourism is suitable for people who want to explore the world around them, but are unable to realize their aspirations due to a lack of material resources or physical limitations caused by illness, injury or similar reasons. Virtual tourism is travel that is free from categories such as distance, distance and transport costs.

VR and AR content dedicated to tourist destinations is a good help for tour operators. It allows them to save time and financial costs in analyzing destinations, transfers, accommodation conditions in different countries and cities, levels of service at different resorts. Travel agencies interested in maintaining a stable rating could attract new clients by using VR and AR technologies in their office work, exhibitions, announcements and other promotional activities.

The use of the latest technology has become an urgent issue for museums. Museums, main purpose of which is the preservation of cultural heritage, should keep pace with the times, develop together with the whole society, offering it comprehensible and interesting forms of communication. There are no other ways out of the "conceptual crisis of contemporary museums" [23] mentioned by the experts. The reasons for this crisis are the methodological turbulence experienced by historical science, the inertia of positivist notions among museum workers, the detachment from dialogue with visitors, and the archaic language means by which the museum heritage is presented.

Today, museums are faced with new imperatives that demand more modern rhythms, pace, and responsiveness. Museums can no longer do without interactive techniques, of which virtual and augmented reality technologies are a part, enabling museums to connect museum exhibits with multimedia, to update museums' communicative baggage, and to enhance interaction with their audiences.

The display of museum relics on a touch screen does not diminish their cultural value; on the contrary, it helps to illuminate additional, previously hidden semantic nuances in them. Virtual and augmented reality can provide clearer and deeper information about the exhibits than even 20–30 years ago. Museum exhibitions are becoming a space in which visitors can immerse themselves in a fascinating journey, generating new cultural meanings and semantic associations, and helping them to learn something important about the past and reflect on the present and future.

A striking example of the new attitude to museum work was the creation of the world's first interactive children's museum "My Future Profession" in the Kazakh capital, Astana. Its project was developed in 2015 by the Moscow studio AR Production, commissioned by the Palace of Schoolchildren in Astana. A team of specialists in virtual and augmented technologies developed the software for the exhibition, which is dedicated to popular professions in Kazakhstan and contains 30 interactive compositions, which are placed on an area of 330 square metres.

The main part of the exhibition was made up of augmented reality objects, functioning thanks to special markers on the wall screens, 3D reality glasses used by visitors and joysticks for interacting with the panels. Augmented reality is represented by a large number of scenes shot in 3D. In order to increase the interest of young audiences and engage them in exploring the virtual exhibits, a gaming model of visitor interaction with the exhibit panels has been implemented. The special value of the museum lies in the fact that schoolchildren not only learn about different professions, but also interact directly with modern interactive technologies, gaining knowledge about advanced spheres of social development and discovering new life prospects [24].

The main point of using VR and AR technology in museums is to remove barriers to access to exhibits. The interested audience is provided with a virtual way to experience museum collections. Using mobile applications, this is made possible by the cooperation of IT companies with cultural bodies, including museums. An example of this is the initiative by Google, which in 2016 entered into partnership agreements with natural history museums around the world. The Google Street View app has been used to launch free online tours [25].

More than thirty of these tours are 360-degree videos, compatible with VR gadgets. Users are now able to remotely experience the collections at the Natural History Museum in London, the Darwin Museum in Moscow, the New York Museum of Natural History and other internationally renowned museum complexes. Twenty virtual "expeditions" involving museum materials have been opened specifically for educational institutions [26].

The need to attract the latest technologies for the development of museums is recognized by the governments of different countries. For example, the Ministry of Culture of the Russian Federation supported a group of specialists who, in 2017, developed and implemented a platform and infrastructure project to create the Artifact programme, which acts as an interactive guide to Russian museums. A special place in the programme is given to artificial intelligence, which allows for image recognition and thus ensures the inclusion of AR technologies.

In addition to exhibitions from major museums in Moscow, such as the Tretyakov Gallery, the Russian Museum, the Pushkin State Museum of Fine Arts, the programme supported by the Russian Ministry of Cul-

ture includes 3D digitized museum collections from Vologda, Arkhangelsk, Kirov, Nizhny Novgorod, Novocherkassk, Totma, Yaroslavl and other cities. The Artifact Programme was originally designed to include as many Russian museums as possible. To date, that number has approached 160 [22].

Museums join the Artefact programme by adding their own content to the single basic platform, which is transformed into an augmented reality using a predetermined electronic algorithm. No special programming knowledge or material costs are required of museum workers. At the same time, museums retain their inherent thematic and style features. The existence of a single project platform allows individual museums to integrate the experience of other institutions and give life to their own ideas on its basis. Conditions are created to equalize the status of various museums by such criteria as accessibility, recognition and attractiveness. Thanks to VR and AR technologies, a fragmented conglomerate of museums is transformed into an integral space held together by common cultural development strategies and the common rhythm of technological progress.

The Artifact app allows users who have downloaded it to their smartphone in app form to get the information they need about both individual exhibits and entire exhibitions. The app can be launched not only inside but also outside the museum. Thanks to augmented reality, the amount of information received does not change depending on the location of use. Virtual and augmented reality makes it possible for people who are not indifferent to cultural heritage to see lost architectural masterpieces or unfinished projects like the Palace of Soviets in Moscow that nearly didn't appear in the 1930s.

Often, AR technology offers museum visitors several content options at once. Using their smartphones, they can learn about the history of museum objects, their condition before and after restoration, and their alternate versions. Art objects and historical relics are presented to the audience in three-dimensional, stereoscopic form. Some artefacts can be seen in X-rays or ultraviolet [27]. While receiving information about the museum objects, listening to the narration of the audio guide, the user of the smartphone app can at the same time "move" from one museum to another if desired. The blurring of boundaries between virtual museums and virtual tourism illustrates the thesis that the latest technology contributes to the transformation of the sphere of culture into a single space, a system of common communications.

Virtual and augmented reality is increasingly being used in the visual arts and theatre. The immersiveness of these art forms has always been high, and modern computer innovations have raised it even higher. The creators of today's immersive art focus on the merging of real and virtual worlds, on the blurring of the boundaries between them. This approach is designed to induce subtle emotional states, to expand the possibilities of human consciousness.

The first experiences with immersive innovations in theatre art are associated with the director Julie Martin, who in 1994 staged "Dancing in Cyberspace", where acrobats and dancers were immersed in a virtual atmosphere created by projecting virtual objects onto the stage [28].

In the 2000s, theatres began to open which purposely departed from traditional stage productions in favour of interactive audience involvement in the theatrical action. The immersion effect is achieved by abandoning the usual theatrical paraphernalia — rows of seats, intermissions and the stage itself. The canva of immersion performances is revealed not in an ordinary auditorium, but in a room or several rooms at once, where there is no distance or space barriers between the collective of actors and the audience — the audience can interact directly with the actors, thereby conducting a "personal" storyline.

In 2007, a virtual theatre in London, Secret Cinema, stood out in its use of immersive technologies; it began broadcasting virtual stories with 360-degree video projections and other special effects. The basic idea behind Secret Cinema is to blur the boundaries between objective reality and the virtual world as much as possible. The basis of the theatre's production strategy is the preparation of gigantic productions which include complex sets and a huge number of performers. The theatrical action takes place in abandoned warehouses and factories, with the audience drawn into the action as direct participants. Secret Cinema extravaganzas recreate the fantasy worlds of the bestsellers Star Wars, Blade Runner, Back to the Future and others [29].

Fabien Riggall, founder of Secret Cinema, said that he "wanted to live inside films since he was a child". Turning a childhood dream into a well-established business, he incorporated the screening of short videos into the format of theatrical events, incorporating elements of music festivals and club parties. One of the reasons for creating Secret Cinema for Riggall was the "growth of digital culture", which did not cancel the public's appetite for the unusual, but only supplemented and "warmed up" it: "People want mystery, they want to experience something unpredictable, and I think that's why Secret Cinema deserves the right to exist" [30].

The immersive theatre Sleep No More, established in New York in 2011, is also very well known. The theatre rents an old hotel for its interactive shows. All the performances of Sleep No More reflect a simulated reality, which for the audience turns into an opportunity to "choose their own adventure", to visit a virtual Wonderland, to interact with the characters of the production, to help solve mysteries. Each spectator can move at his or her own pace and view the scenes they like for as long as they like. Surrealistic and emotionally intense productions let theatre-goers into the world of Shakespeare, Carroll, Webber and other playwrights of the past [31], reimagined in the spirit of the 21st century.

Following London and New York, immersive performances have continued in other major cities around the world. In particular, an innovative musical Black Russian was staged in Moscow in September 2016. It was directed by Maxim Didenko, a specialist in theatrical phantasmagoria. Staged in a specially rented mansion, the musical was received by audiences as "a hellish mixture of Russian classics and theatrical art house, a web of double, triple, infinite meanings" [32]. Moscow then produced a whole series of immersive performances based on non-standard technological solutions.

Many contemporary painters, graphic artists and designers aim to introduce innovative techniques. They periodically organize exhibitions, shows, and installations where various means of visualization are combined. The shows are often bizarre combinations of moving pictures, 3D video clips, mirror mazes, various lighting effects, music or voice accompaniment, projections of visitors' movements, etc. Among the most high-profile installations is Androyd Jones, whose fame in many countries is due to his exhibition "Samskara" (Unconscious Impressions).

The Japanese immersive project "teamLab", famous for its unusual shows and installations in which art, science, technology, design and the natural world merge, has gained considerable popularity with international audiences. Digital technology has enabled teamLab to create artifacts that transcend the boundaries between physical phenomena and the phenomena of human consciousness [33].

The Mexican group Meon Wolf, consisting of two hundred creative individuals — painters, graphic artists, sculptors, architects, photographers, videographers, specialists in VR and AR-technologies — have also noted their unconventional approaches to art. A special feature of Meon Wolf's creative method is the creation of installations that expressively combine fantastical-surrealistic, fairy-tale-magical, mysteriously-hypnotic subjects and motifs [34].

The number of personalities realizing their creative potential in immersive art is constantly increasing. Among them there are leaders whose ideas and projects are of interest all over the world — Miguel Chevalier, Vincent Howze, Rachel Rossin, Refik Anadol. These internationally born artists live in the United States. Their experiments are cloaked in large-scale digital installations, exploring themes such as the intangible in art, and the relationship between nature and architecture, painting and sculpture. In developing these themes, art is transferred into the digital world, virtual cities, continents and entire galaxies are created; using in-situ techniques involving digital tools, 3D and laser cutting, the architectural history of various places is revisited and images are generated questioning all stereotypical perceptions of the surrounding reality. The artists named are known for their exhibitions in museums, galleries and art centres, as well as for their original ideas implemented in various sectors of public and architectural space, thereby leading to the materialization of virtual images [35].

The successes of some serve as a stimulus for the activation of others. Creative breakthroughs by representatives of American immersive art resonate in various countries around the world, including Russia. For example, in 2018, the Moscow-based new technologies studio Great Gonzo began to practice virtual painting shows, offering visitors to public events to "get inside" a particular painting masterpiece with a VR helmet [16; 43].

Moscow VR-cinema AtmaSphere 360 has not limited its functions to video screenings, but has become a multidisciplinary creative art location, a platform for daring artistic experiments. Virtual films are often combined here with motion graphics, digital art, live shows, different types of animation, etc. "Atmosphere 360" is not so much a cinema as a multimedia hall, where, on the basis of VR and AR technologies, the interaction between various means of visualization, different artistic genres and styles is being "polished". Elena Kosolapova, curator of Atmosphere 360, put it like this: "Atmosphere 360 is an audacious experiment, an attempt to create a new format of museum, theatre and cinema, where emotions can move in waves from creators to consumers and back. An ordinary space becomes a living, breathing, vibrating organism: artists present their vision of reality, and the audience comes into contact with digital art and penetrates the virtual space" [18].

It can be considered an indisputable thesis that linking culture with advanced information technology gives it the widest possible perspectives. At the same time, it would be wrong to move away from realism, closing our eyes to the factors that hinder such a connection, that hold it back. They concern the development of both the sphere of culture and modern technologies.

The impact of virtual and augmented reality on the consciousness and psyche of users has not yet been sufficiently studied. This issue has a social and ethical dimension. It is particularly relevant for children and adolescents. More research is needed on the ethical and age-specific aspects of users' interaction with virtual reality. Experts in VR and AR technology have spoken of the great usefulness of such research. In particular, British scientist Ben Kenwright points to problems such as hacking, the existence of ways to "immorally exploit technology", and the adaptation of socially immature minds in "complex interactive virtual worlds". According to him, "ethical issues arise because virtual reality technologies are widespread and difficult to classify and identify, and because it is difficult to predict the short- and long-term consequences of their use" [8; 20-21].

From a technological point of view, the high cost of introducing new VR and AR developments into production remains a tangible problem. They are largely based on the enthusiasm of enthusiastic people, which is not always supported by sufficient organizational and financial support from large companies, corporations and investment funds, which has led to the problem of the high cost of VR and AR hardware.

At present, the development of VR and AR technologies is associated with the search for breakthrough solutions in improving and reducing the cost of broadcasting devices and headsets, and in developing their latest models. This search is primarily focused on functional and aesthetic improvements to VR helmets and AR glasses. In recent years, Valve, Facebook, Sony, Google and other computer technology companies have begun to develop and produce affordable VR and AR devices. The emphasis is on displays with high screen resolution [36]. However, despite certain advances in the improvement of devices, due to the inertia of the consumer market, hardware that is perceived by consumers as expensive, bulky, uncomfortable and unattractive in terms of design still prevails. The audience's reserved attitude towards VR helmets and VR glasses reduces the motivation of directors and producers working in VR filmmaking to create feature-length films, limiting their efforts to "short films".

The promotion of virtual and augmented reality techniques is hampered by the lack of trained professionals who could work not only on the software, but also on the content and scenarios of VR and AR products. In order to eliminate the human resources problem in this area, it is necessary to train professionals in universities. The first steps in this direction have been taken in various countries. For example, in Russia, in 2019, the Higher Engineering School based at MEPhI introduced a master's educational programme "Virtual and Augmented Reality Technologies for the Design of Technological Systems" [22]. However, there is still a lot of work to be done to train a sufficient number of specialists in the new field.

The practical difficulties that have recently arisen in the global VR and AR market have a lot to do with the Covid-19 pandemic. A number of things — social isolation, the shift of many institutions and companies to remote working, the widespread use of remote methods of communication, etc. — increases audience attention to VR and AR experiments, which would seem to increase the consumption of VR video content, and with it the demand for VR helmets. But VR specialists do not confirm this trend. For example, A. Ivashentsev, organizer of the independent media association Mixed Reality Conference, is convinced that VR-helmets are not sufficiently distributed among the mass audience, which amounts to low figures in the consumption of VR-content [13].

One problem is that many tour operators and cultural and sporting institutions are understandably unenthusiastic about the mass distribution of VR and AR equipment to ordinary users.

There are other problems as well. The encouraging trend in the market for VR and AR products should not detract from their analysis. The Covid-19 pandemic is dictating harsh conditions to the computer technology market, undermining previously established economic ties, preventing new contacts, disrupting the supply chain for raw materials, components and finished products, imposing restrictions on retail sales, and zeroing out advertising costs. In other words, the issues surrounding the quality state of VR and AR hardware and its high cost have gone nowhere during the pandemic. For now, advocates of VR and AR technology promotion have to work on their belief in a better outlook.

Conclusions

According to M. Nikonov, the creator of RosVR Studio, "when technology provides relatively affordable prices for VR helmets and high-quality content, demand for VR projects will soar, and it will be the sec-

ond breath of the VR industry — in the virtual reality format, all the twentieth-century movie patterns will play out in a new way" [13].

The leap in the development of the VR industry predicted by experts will affect more than just cinema. Virtual and augmented reality technologies bring a new quality to all branches of culture and art dealing with visual images. As shown above, VR and AR technologies allow users to virtually visit museums, theatres, exhibitions, sporting events, and tourist sites, giving them the feeling of being fully present. For many users, saving time and money is an important benefit.

The IT industry has become a driver of increased cultural demand from different sectors of society. In turn, the majority of society's access to print, music, video and photography via PCs and smartphones has led to an ever-growing presence of the IT industry. The use of modern information resources, including VR and AR technologies, helps users to activate their thinking activity, thereby increasing their control over the perception of external phenomena and processes and improving the quality of decisions made when performing theoretical and practical tasks.

The application of the latest technologies in the cultural sector facilitates overcoming barriers of meaning and departmental divides between different sectors of creative activity and creates a sustainable basis for transforming culture into a unified information and meaningful space.

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Д.А. Сиражиден, Г.С. Касбаева, Бюлент Шенай

VR және AR технологиялары қазіргі мәдени кеңістікте

Мақалада мәдениет пен өнер саласындағы виртуалды және толықтырылған шынайылық технологияларын қолдануға байланысты тақырыптар қарастырылған. VR және AR технологияларының маңызды сипаттамалары берілген. «Иммерсивтілік» ұғымының мәні ашылған. Авторлар қазіргі мәдени кеңістіктегі VR және AR технологиясының техникалық және технологиялық аспектілерін, сондай-ақ мәдени аспектілерді зерттеген. Виртуалды және толықтырылған шынайылық технологияларының иммерсивті әсерге де, белгілі бір визуализация әдістерін қолдануға да ашық мәдени кеңістік секторларымен, яғни киномен, мұражайлармен, туризммен, театрмен және бейнелеу өнерімен өзара әрекеттесуінің негізгі заңдылықтары мен ерекшеліктері анықталды. Мәдениет пен соңғы технологиялар арасындағы өзара әсердің сипатын анықтайтын факторлар талданған. Сонымен қатар, мақалада иммерсивті технологияларды қолдану арқылы орындалатын бірқатар тапсырмалар және оларды Artifact бағдарламасында пайдалану мысалдары келтірілген. VR және AR технологияларын қолдануда әлеуметтік-этикалық және маркетингтік факторларға қатысты мәселелер анықталды. Мәдениет саласындағы соңғы технологияларды пайдалану шығармашылық қызметтің әртүрлі секторлары арасындағы шекараларды еңсеруге көмектеседі және мәдениеттің біртұтас ақпараттық-семантикалық кеңістікке айналуының алғышарттарын жасайды деген қорытынды жасалды.

Кілт сөздер: виртуалды және толықтырылған шынайылық технологиялары, мәдени кеңістік, өнер, иммерсивтілік, визуализация.

Д.А. Сиражиден, Г.С. Касбаева, Бюлент Шенай

Технологии VR и AR в современном культурном пространстве

В статье рассмотрена тематика, связанная с применением технологий виртуальной и дополненной реальности в сфере культуры и искусства. Даны сущностные характеристики VR- и AR-технологий. Раскрыта суть понятия «иммерсивность», технико-технологические аспекты технологии VR и AR в современном культурном пространстве, а также культурологические аспекты. Выявлены основные закономерности и особенности взаимодействия технологий виртуальной и дополненной реальности с секторами культурного пространства, открытыми как иммерсивного воздействия, так и для использования тех или иных техник визуализации — с кинематографом, музейным делом, туризмом, театром, изобразительным искусством. Проанализированы факторы, определяющие характер взаимного влияния между культурой и новейшими технологиями. Кроме того, в статье представлен ряд задач, выполняемых с использованием иммерсивных технологий, и примеры их использования в программе «Артефакт». Выявлены проблемные точки применения VR- и AR-технологий, касающиеся как социально-этических, так и маркетинговых факторов. Сделан вывод о том, что применение новейших технологий в культурной сфере способствует преодолению границ между различными секторами творческой деятельности, создаёт предпосылки для превращения культуры в единое информационно-смысловое пространство.

Ключевые слова: технологии виртуальной и дополненной реальности, культурное пространство, искусство, иммерсивность, визуализация.

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