AR and VR Technologies as a Factor of Developing an Accessible Urban Environment in Tourism: Institutional Limitations and Opportunities

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Abstract: *Prospects for the use of virtual and augmented reality technologies for the development of an accessible urban environment in tourism are discussed in the article. The institutional limitations and opportunities for digital development of territories through the use of hybrid environments of mixed reality are revealed as a factor in the development of an accessible urban environment in tourism. New perspective directions are proposed for improving the institutional environment and sustainable positive dynamics of social rehabilitation, reducing social tensions, filling the free time for recipients of tourist services. The vectors of territories digital development are determined.*

Index Terms: *virtual reality; augmented reality; tourism; urban environment; inclusive tourism; institutional limitations; institutional environment.*

I. INTRODUCTION

The problem of developing an open environment is the priority direction in the policies of developed countries in accordance with the requirements of the UN Convention on the Rights of Persons with Disabilities in present socio-economic conditions. Special importance is attached to the issue of creating conditions providing an independent lifestyle, promoting active social rehabilitation, self-actualization and self-realization for persons with disabilities. Any restriction in access not only to the social infrastructure, but also to the service sector is perceived as a manifestation of social inequality.

Digital technology and digital economy relate to the most discussed topics of discussion in the field of economic policy. Digitalisation is a systematic process that permeates macroeconomic systems at all levels of their hierarchy, from national markets and sectors to individual jobs. Therefore, it is no coincidence that the regional and especially the urban scales of the development of the digital economy attract the special attention of specialists.

Institutional hybridity is the result of the merging of the real and virtual worlds, characterized by the possibility of performing all the "vital" actions in the real world through the virtual one. High efficiency and low cost of information and communication technologies (ICT) and the availability of digital infrastructure are prerequisites for this process.

In recent years popularity of the hybrid environments of mixed reality (MR) have increased as they provide an attractive and exciting experience for educational, entertainment, and academic purposes. The increasing progress of Augmented Reality (AR) and Virtual Reality (VR) hardware and software technologies also creates an interesting area for applications in research.

VR (virtual reality) and AR (augmented reality) have been embedded in education for many decades. These technologies are widely used in educational programs, including astronomy, medical education, engineering, physics, geology, biology, chemistry, mathematics, geometry, language learning, art, interactive books, training new teachers and many other disciplines. These technologies are widely used in such industries as guided tours, industrial design and maintenance, museums, laboratory modeling and the most popular games. These technologies have allowed teachers to overcome the limitation of space and / or time of educational process and bring students a completely new experience. Many empirical studies show that the use of VR and / or AR-technologies in education has had a positive impact on the involvement, understanding, process and student learning outcome. However, there are still problems with the use of these technologies in a wide range of educational programs by reason of some obstacles, such as high cost of devices, high cost of developing content for educational purposes, training academic specialists and teachers to introduce these technologies in their educational institutions, teaching methods, etc. For example there is the technology that immerses you in ancient Rome.

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If this technology complements the surrounding space with various objects from that era (swords, armor, earthenware jars, temples, arenas) then this will be considered as AR technology. But if you are transported to the ancient city with its architecture, people, weather, events, etc., but, for example, the faces of the people will be broadcast from the outside world, then this is technology of augmented virtuality (hereinafter - AV).

At today's level of development, AV technology is almost never used, but it may become much more impressive than AR and VR in the future. They often assume that human existence will shift into a mixed reality (MR) space, which is already observed because of the development of the Internet and mobile devices showing us the forecasts of the development of technology. Mobile devices can be considered as AR augmented reality technology within a virtual-real continuum, since they complement the world around us with additional visual, audio and somewhat tactile information.

The use of virtual and augmented reality (VR / AR) in the tourism industry is a subject of growing interest for both researchers and companies [1]. By virtue of their characteristics and ability to entertain users, in fact, AR and VR have found various applications in this sector, such as expanding tourist travel [2], increasing the availability of fragile or remote areas [3], training and guiding tourists [4] and expanding global interactions between travelers [5].

II. PROPOSED METHODOLOGY

In this study, various methods of factorial, level subject-objective analysis are used, within the framework of a systems approach to identifying institutional environment constraints through hybrid of the mixed reality environments as a factor in the development of an accessible urban environment in tourism and identifying opportunities for digital development of territories, including innovative methodology of post-institutional analysis based on multi-paradigm and interdisciplinary synthesis.

Attempts to create interactive devices with the ability to interact with the simulated reality and complement reality were made at the beginning of the XX century. The first technology of augmented reality in its modern sense was developed by scientist Ivan Sutherland and his student Bob Sproul in Harvard in 1968 when the first VR-AR helmet which is a portable information display system with the ability to project a virtual environment onto the physical was created [6].

Authorship of the term "virtual reality" belongs to Jaron Lanier, an American scientist in the field of data visualization and biometric technologies. In the mid-1980s, he became the first man who actively commercializes virtual reality technologies [7]. The term "augmented reality", authored by Thomas Preston Caudell, first appeared in Boeing in 1992, in "Augmented reality: an application of technology for manual manufacturing processes" in the description of digital displays in aircraft [8].

And if the concept and principle of virtual and augmented reality has not undergone significant changes lately, technologies have undergone a significant evolutionary path and several growth spurts.

A study conducted in 2016 by representatives of Bank of America Merrill Lynch emphasize that "along with cloud technologies, artificial intelligence, augmented and virtual reality technologies will become key technologies of the fourth industrial revolution" [9]. In this connection, the use of virtual and augmented reality has great potential not only in the field of games, entertainment, medicine, creation of software products for engineers, architects, designers, but also in the social sphere, including low mobility population-oriented tourism. Scientific articles dedicated to the use of AR-VR technology are overviews and they do not adequately reflect the issues of this article. The most comprehensive classification of promising areas of augmented and virtual reality technology is reflected in the article by A.V. Ivanova, "Virtual and Augmented Reality Technologies: opportunities and obstacles of application", which notes the superiority of virtual reality over augmented one in the areas of entertainment, games and tourism being more interesting for the consumer [6].

In foreign scientific literature the problem of interaction of people with limited mobility with virtual technologies is often considered in terms of possible medical and social rehabilitation.

Virtual reality is considered in the article "A hedonic motivation model in virtual reality tourism: Comparing visitors and non-visitors" as one of the most significant topics in modern information environment of many areas of human life including tourism. The author uses the definition of VR tourism, i.e. virtual reality tourism, which is defined as a virtual representation of the actual attraction, destination or visitor experience, which is designed as a prelude to the visit or to extend the previous customer experience. VR technologies remove the barrier in the distance for potential tourists who want to get information about their destination before making a decision about buying and visiting, transforming the way people travel and experience their location [10].

Ruhet Genc, the author of the article "The Impact of Augmented Reality AR Technology on Tourist Satisfaction", notes that AR technologies used in the tourism industry increase the degree of involvement of various categories of the population in tourism activities. Besides full immersion a user in a synthetic environment, AR imposes computer data, allowing the user to improve his perception of reality and the environment [11]. The result of the analysis of scientific papers on this topic is necessity to note the fragmentation of studying the problem of using AR-VR technologies to expand the boundaries of the urban environment in tourism, which makes this topic so relevant.

The main promising and demanded type of tourism aimed at expanding the boundaries of the accessible environment is conducting excursions using AR-VR technologies by supplementing or replacing the guide with visual information about objects, creating interactive exhibitions or museums with the opportunity to transfer to not only another city or country, but also another century, the re-creation of not only the appearance of museum exhibits, but also imitations of the direct being within the walls of famous museums and expositions.

This type of excursion is implemented by museums all over the world. Currently, the National Forest Museum has an installation called Forest History, which is dedicated to images from the collection of natural science paintings by William Farquhar, whose visitors download the application and can then use the camera on their phone or tablet to study the paintings [12].

Digital technologies are a factor contributing to the intensification of social interaction [13]. The use of virtual and augmented reality allows you to expand the boundaries of the accessible environment and it allows people with limited mobility to visit places where they cannot get on their own. The largest museums of Russia have created their own web sites on which their expositions are located. A person has access to such historical places as the Moscow Kremlin, the Armory and the Hermitage during a virtual tour [14].

The creation of tactile museums has become a new milestone in the spread of AR-VR technologies in the social sphere. The projects are aimed not only at expanding the boundaries of the accessible environment, rehabilitation and spiritual development of the personality of people with disabilities, but also learning how to interact with people with disabilities, understand their world of sensations, and develop humanity. The first tactile museum for the blind and visually impaired was founded in Athens in 1984 [15]. The exhibits of the museum are exact replicas of statues, vessels, sculptures presented in the museums of Greece, the originals of which were digitized and recreated in the form of 3-D models after centuries. The practice of creating tactile museums is also reflected in Russia; at the end of 2019, the first permanent exhibition in Russia devoted to the history of Russia and St. Petersburg in sculpture and plastic will work in the branch of the State Russian Museum for visually impaired visitors [16].

Modern digital realities allow all people without exception to travel the world in a completely new way. The use of augmented reality technology provides people with limited mobility access to new impressions of travel, adventures inaccessible to them due to objective reasons through applications and VR equipment. That way the technology of a 360-degree video about skydiving, hang-gliding, skiing for virtual reality glasses allows you to immerse yourself in the world of athletes, actors and activists with disabilities [17].

Currently, there are a number of AR mobile applications in the world that are used to expand the boundaries of an accessible environment on travel and tourist routes. Their application is of particular importance both for people with limited mobility, allowing them to create the illusion that computer-generated or computer-added objects exist in real time and close proximity, as well as for people who are deaf or dumb, visually impaired, or people with poor coordination.

Layar, Acrossair and Wikitude, MobiAR are the most famous applications of virtual and augmented reality [18]. The principle of their work is similar, they allow you to explore your physical environment, transfer location data, call any information from the Internet, including information about tourist attractions, access to information about hotels, cafes, vehicles. Examples of the ability of AR to increase accessibility for people with disabilities are the signboard, which has a number of requirements [19]. A visually impaired person who finds it difficult to read a small font can see how the sign expands to a larger font by clicking on the icon in the application using the camera.

It should be noted that AR-VR technologies are a cultural phenomenon that can be productively used as one of the modern assistive technologies that actively help the socialization of people with disabilities and the formation of an accessible urban environment. In this regard, one of the priority areas in tourism activities both in Russia and in any subject of the Russian Federation is the use of the most promising forms of virtual and augmented reality. In accordance with the approved Concept of the federal target program "Development of internal and inbound tourism in the Russian Federation (2019–2025)", it is planned to grant support to public and business initiatives aimed at creating and developing tourist infrastructure facilities, clusters, encouraging the use of new technologies including information technologies, environmentally sustainable tourism practices, technological standards for barrier-free tourism for all category of citizens, including limited mobility [20]. Natural-climatic, geographical, cultural, historical and recreational resources of the Volgograd region allow to fully implement this task. In accordance with the Volgograd Socio-Economic Development Strategy until 2030 [21], the key direction in creating conditions for the formation of the urban cultural environment is the development of tourism and its infrastructure, within which special attention should be paid to expanding the boundaries of the accessible environment, namely both social adaptation of older people and creating conditions for accessibility of priority social facilities for people with disabilities and other people with limited mobility. Technologies of augmented and virtual reality will allow realizing this direction fully.

Positioning Volgograd as a center of patriotic tourism, the presence on the territory of the Volgograd region of numerous cultural and historical objects, the heritage of the Great Patriotic War can contribute to the widespread use and rapid development of the use of AR-VR technologies to create virtual tours to places of military glory of the Battle of Stalingrad for tourists. It also can be tours for people with limited mobility and people of different ages, for whom a direct presence at a number of tourist sights including the territory of the main symbol of Volgograd the historical memorial complex "To Heroes of the Battle of Stalingrad" at Mamayev Kurgan, not impossible. This type of excursions can be an application for VR glasses, which are a synthesis of modern video and aerial photography, audio and visual information about historical objects and events, historical chronicles and frames that complement the existing look of Volgograd. The use of such an application is possible both on remote access and with the direct participation of tourists and finding them in accessible to all categories of the population and with developed infrastructure territories, which is essential for people with limited mobility.

III. RESULT AND DISCUSSION

Indeed, VR and AR applications have great potential for promoting travel to specific destinations which affects the decisions of travelers with the ultimate goal of increasing visits to certain websites. Knowing this, travel companies are trying to improve the visual presentation, which is currently the main means of promoting tours, by introducing VR / AR technologies into their marketing campaigns. So, in fact, they can give potential customers the opportunity to get acquainted with the virtual world and "feel present" elsewhere, helping them to make more informed decisions on their choice of tours and create realistic expectations regarding about future real experience [22]. Moreover, recent studies have shown that ordinary audiences have become more resilient to traditional visual media as sources of information [23], and so we can assume that only information transmitted in an innovative way and in the context of enriched data is capable of captivating new potential customers, erasing institutional boundaries and opening up new opportunities through the use of a hybrid environment and increasing the accessibility and involvement in the digital space of the regions. AR and VR can solve this problem, also taking into account that the use of VR / AR is now widely available thanks to the new generation of mobile devices supporting these technologies and the distribution of inexpensive devices for rendering 3D and VR content in the form of CardBoard. Tourism opens up new prospects for sustainable positive dynamics of social rehabilitation, reducing social tensions, filling social service recipients' free time with socially significant and interesting affairs, contributes to the intellectual and spiritual development of an individual, forms cognitive interests and a favorable climate in the micro-society. Accessibility of tourism is providing a universal opportunity to travel and use the services of the tourism industry without any restrictions. However, even if all the criteria for the organization of an accessible environment are met, by reason of objective physical and material (financial) reasons, familiarity with the objects of tourist attractiveness may be limited for many people with disabilities. The solution of this social problem is possible through the introduction of virtual and augmented reality technologies aimed at people with disabilities into the tourist practice. Despite the growing popularity of virtual and augmented reality technology in Russia, theoretical studies of the practice of using AR-VR in inclusive tourism have not been conducted in our country before.

The creation of the first Russian tactile archaeological museum on the territory of the Volgograd region is also promising and innovative for Russia direction of application of VR-AR technology to expand the boundaries of an accessible environment. The territory of the modern region is rich in archaeological monuments, reflecting the milestones of its centuries-old history. The result of many years of excavation by Volgograd scientists was the creation of a unique archaeological artifacts collection, allowing to reconstruct the social, economic and historical processes taking place on the territory of modern Russia for several thousand years. But the value of preservation of found archaeological objects is so small that it is often not possible to put them in museum expositions. In this regard, the use of virtual technologies is a salvation in their preservation in particular, and popularization of the history of the Volgograd region in general. The exposition of the tactile museum can be a combination of digitized and newly recreated 3-D copies of the most historically significant and interesting archaeological finds, which anyone can touch, including the visually impaired, the use of VR glasses will allow you to become a direct participant in not only this process, but also the process of excavation, to become an archaeologist for the duration of the excursion, able to independently find the gold of the Sarmatians with the virtual reconstruction of the process of creating archaeological complexes.

IV. CONCLUSIONS / RECOMMENDATIONS

Through technologies of augmented reality, objects that were previously inaccessible or could not be used due to dexterity problems or due to objective physical reasons became accessible to people with disabilities. Different categories of people with disabilities interacting with 3D models have got the opportunity to visit museums with the help of applications, and the use of AR guides made art, historical objects and events accessible for familiarization and understanding by various categories of people with disabilities. The created applications provide an opportunity not only without outside help or knowing the language, to move around new places, but also to facilitate the process of communication and interaction with others, to make the rest as comfortable as possible. These programs are widely used by people with hearing disabilities and people with speech apparatus problems, and also people with autism spectrum disorders, for whom the main difficulty is the need to interact with others around them. And the ability to supplement information about objects and routes with comments and feedback allows you to find out the level of its accessibility to visit by various categories of people with disabilities planning trips. The presence of a unique for Russia museum and socially oriented virtual tourist programs and applications on the territory of the Volgograd region will increase the tourist attractiveness of the territory, and the virtual programs available to people with disabilities will create prospects for sustainable positive dynamic of social rehabilitation.

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