Classification of Virtualization Processes of Socio-Economic Systems

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The urgency of the work is justified by the acceleration of digitalization in connection with the COVID-19 pandemic, the adaptation of society to the conditions of remote living.

During virtual meetings and conferences, distance education, online business, the direction of VR technology has developed rapidly. The role of VR in the visualization of commercial and creative development is growing rapidly, leading giants are more likely to use virtual reality technology to attract attention to their product The article examines and classifies the structure of VR technologies in the modern world, in particular, analyzes the impact on cultural development, learning and health, through the creation of new hardware and software in the direction of the research topic. Innovative approaches to the diagnosis and treatment of certain human diseases, the process of training and honing skills by doctors using the latest equipment with augmented reality technologies are described. The classification features of the use of VR technologies by field of use, source, methods of use in business and the effects obtained are analyzed and systematized. The development of virtualization in the field of business in recent years has been demonstrated, and the use of VR technologies to increase company profits has been studied. Thanks to VR in visualizing the commercial strategy of the clothing brand, it was possible to improve the number of orders by changing the concept of fashion shows, namely by removing models for clothing, which allowed us to focus only on the product. The calculation of financial costs when using VR for business in comparison with usual methods of marketing is resulted, the influence of innovative visualization technologies on increase of profit of companies is investigated. The impact of technology on economic, technological and social areas in the fields of business, entertainment, healthcare, art, education and military-industrial complex is described.

Key words: Augmented reality, digital age, metaverse, virtual reality, visualization, virtualization

Abbreviations:
VR – Virtual reality;
AR – Augmented reality.

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Introduction

Scientists counted that the pandemic caused by the COVID-19 virus has shown humanity extremely acute problems, such as: namely: social isolation, quarantine restrictions,

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restrictions on the movement of people, decline in some areas of the economy (for example, entertainment, trade), decline in employment. Solving these problems requires new decisive action, political decision-making, the use of innovative models and mechanisms in economic management, based on research. Society adapts to new economic conditions, life, actively using information and communication technologies. For example, according to research by the International Labor Organization, 27% of the population in developed countries have fully switched to distance learning, in terms of education, according to UNESCO, 90% of schools and universities around the world have switched to distance learning. In a video conference, the CEO of Microsoft said that in two months they had to go through "two years of global information transformation." The company's service for online meetings Teams, according to them, in one day used 200 million people at a time. In recent years, virtual meetings, conferences, distance education, online business, the provision of services with immersion in VR, the use of VR in various business areas have developed significantly. Therefore, there is a need for in-depth study of the impact of these processes on the social, environmental and economic component of social development. The article proposes to focus on the development of a classification of virtual reality to structure information on the peculiarities of the development of VR and systematize its various manifestations.

Topicality

Analyzing previous studies, it can be argued that despite the variety of issues that have been covered by researchers, at present there is no holistic classification structure of BP. Thus, the purpose of this study is to form a classification of BP in socio-economic systems.

Analysis of previous research and publications.

It should be noted that a number of publications are devoted to various aspects related to virtual reality, which reveal the interdisciplinarity of this scientific issue. This, in turn, also requires systematization of data on the virtualization of socio-economic systems. Publications of both Ukrainian and foreign authors were analyzed. In [1] the issue of business, which creates virtual reality as a business product, is investigated. The authors conclude that the creation of virtual glasses is just the beginning on the way to creating business ideas in a still relatively free branch.

The paper [2] actualizes the issues of VR technologies in modern culture, and their issues and prospects for development in modern creative industries, such as cinema, tourism, museums and galleries. It is demonstrated how VR technologies are used in solving the problems of visualization of creative industries and various problems of society.

The author of the article [3] considers education as one of the most popular areas of virtual reality development. This paper analyzes the current state of the Government as a new level of information technology development and examines the impact of the Government on all spheres of society. It is revealed that at the present stage it is easiest to implement elements of virtual reality in multimedia educational complexes in the form of simulations of models of the professional environment or structural and organizational schemes. However, it is concluded that the basis of simulations are technological scenarios, which in turn are based on pedagogical scenarios.

The work [4] is devoted to the study of the use of VR applications in the field of construction in the United States and Great Britain. 11 organizations that are leading users of technologies were studied. The author identified their strategies and business incentives for the use of VR. Research has shown that early followers focused on using virtual reality either for system integration, or for user interfaces, or for developing new markets.

Article [5] presents the results of a joint project in which students from two countries work together to explore the possibilities of using VR in a business context and then create their own VR scenes for a chosen business or industry. At the same time, students follow the scenario of virtual mobility, in which they explore the possibilities of BP both in the context of business and in the context of learning technology. In general, publications on VR can be divided into the following: Group I considers VR as a finished product, and Group II - as a tool for use in various fields.

Research methodology

This work is based on scientific methods of system and structural analysis.

Methods of system analysis were used in the formation of a system of classification features. Methods of logical generalization are used in the analysis of the scientific literature to distinguish classification units. Given that our study is fundamental, the authors in this article used secondary data of textual and visual information. The sources used are literature reviews on research topics, data from Internet sources such as Google Scholar and Scopus.

Research results

To create a comprehensive classification of virtualization of socio-economic systems, we consider it necessary to highlight the basic definitions in this matter. In order to better understand the essence of virtualization, the study provides several definitions of this concept.

Virtualization is the process of using, creating a software (or virtual) representation of various phenomena, such as virtual applications, servers, repositories and networks. This is the only and most effective way to reduce the cost of IT infrastructure while increasing efficiency and adaptability for companies of all sizes [7].

Virtualization is the combination of various computing resources and their subsequent transfer from a physical machine to a virtual one. [21]

Virtualization is a technology that allows you to create useful IT services using resources traditionally associated with hardware. This allows you to use the full power of the physical machine, distributing its capabilities among many users or environments. [22]

Given that the classification is a system of division of objects or concepts of a particular industry into classes, departments, categories, etc. [8]; or attribution of objects, elements of a set to a class (elements which are characterized by a certain essential feature or group of essential features) [9], in this study the classification of virtualization of socio-economic systems, with emphasis on the use of virtual products in economic direction.

The development of the classification of processes and phenomena is carried out on the basis of determining their specific forms, features, types - classification features.

Based on the acquired knowledge of the authors, this study offers the following classification features

1. By scope:
- As a tool for business
- In the field of entertainment
- In health care
- In art
- In education
- In the military-industrial complex

2. By sources of origin:
-The final product
- Service

3. By areas of use in business:

- In strengthening the marketing strategy (visualization of products and services)
- Management (for business process management)

The first classification feature is the scope of use.

Virtual business is becoming one of the main aspects of market competitiveness in the digital age. There has been a rapid development of virtualization in business in recent years. According to Microsoft Bing and Google Search, search queries related to the word "virtual" increased 25 times between March 31 and April 6, 2020 compared to March 31-April 2019 [10]. Virtual reality headsets are becoming more affordable and in demand. Due to quarantine restrictions, hundreds of millions of people have switched to online shopping, video communication, and work from home. With the change in lifestyle, consumer behavior has also changed. Due to this factor, the market is forced to modernize supply, keeping pace with the times.

Instead of visiting the showroom, a customer who leads a more digital lifestyle (or for some reason cannot visit it) uses the headset and visits the virtual showroom. Interacting with vendors, which can be virtual representations of real people, or, more possibly, subsequently constructions that work directly from direct human control.

If the client wants to try a new car, furniture, or kitchen appliances, VR will allow you to do so without leaving home. Of course, real showrooms will remain part of the marketing landscape for some time, as for many products there will be a time when the consumer will seek to see and feel the physical product. But for early market research and a quick overview of the brand's virtual product range, virtual reality will often offer a convenient alternative.

Thousands of well-known brands are already using virtual reality in their activities to ensure better service or product and increase competitiveness in the market.

Furniture giant Ikea already offers virtual showrooms, which has set a good example for other retailers. The Hanifa clothing brand attracted the attention of many with its virtual 3D display, which did not have models, but only the clothing itself, which allowed to concentrate on the details. Thanks to innovation, the brand has collected a significant number of orders, despite the crisis [12].

Virtual reality has gained the greatest popularity in the field of entertainment. Today, virtual reality can be accessible to everyone, thanks to a variety of types of equipment. Pricing policy varies from UAH 100 and exceeds 100 thousand UAH. The simplest and most affordable are cardboard 3D virtual reality glasses, for their use you only need a phone with special programs.

The size of the global virtual reality market in the gaming market was estimated at $ 11.56 billion in 2019 and is expected to grow at an average annual growth rate (CAGR) of 30.2% between 2020 and 2027. The industry provides gamers with attractive virtual accessories that improve user interaction and provide immersive participation. Continuous updating of prevailing technologies, including motion tracking, 3D effects, and interactive graphics to attract players' attention, is expected to stimulate industry growth. Users need new-fangled sources of entertainment due to the sharp increase in their purchasing power, and therefore it is believed that they participate in virtual reality games [13].

The virtual reality gaming space expands its professional value through new innovations. Players' awareness of modern virtual reality accessories such as headsets, bodysuits and gloves are growing rapidly. VR headsets, which went on sale in 2016, revolutionized the leisure industry. The launch has led to a sharp increase in the demand for games in virtual reality, as users sought to meet three-dimensional characters in their virtual environment. Virtual reality

gadgets used in the market are equipped with intelligent interactive equipment and software that expand the possibilities of entertainment for users.

Figure 1. 3D display of Hanifa branded clothing

By type of use, the market of virtual entertainment is divided into commercial premises and individual users. There is a significant increase in the number of VR gaming zones and arcades around the world due to their ability to allow consumers to completely isolate themselves from the real world and experience the simulated world created in this space. Young people are more attracted to commercial spaces such as arcades, cafes and amusement parks, as they offer excellent virtual reality in games at reasonable prices on an hourly basis. Commercial spaces provide a great experience with large outdoor areas and improved interaction with virtual reality, giving users a more complete immersion.

Virtual reality in medicine is divided into three areas - for medical education and training, for diagnosis and treatment of certain diseases.

With the help of virtual reality glasses, future doctors have the opportunity to visit inside the human body, even increase the scale for the study of cells, which is much more effective than a plastic model, which can be remembered from biology lessons. Lume VR Ltd. together with scientists from the University of Cambridge, they developed the vLUME software, which allows not only to reproduce a high-quality model of the cell, but also to analyze its functions [14].

In surgery, honing motor skills is very important, so virtual reality is becoming increasingly popular in this area. It has significant advantages over anatomical theater - it reduces the cost and increases the variety of training. For example, the Russian company

thePSYCHO recently developed a prototype of a surgical VR simulator for laparoscopy. The system uses a high-precision tracking system and tactile feedback, which provides high reliability of the simulation [15].

Doctors already know "smart" devices for X-ray mammography, chest radiography, radioscopy, and so on, which display the information in a convenient form of 2D-image or 3D-reconstruction [15].

Another example is the Microsoft Hololens glasses, which are used in conjunction with VR Corp. After the X-ray examination, the doctor puts on these glasses and is able to see a 3D visualization on the patient's body, which displays all the necessary diagnostic information. In fact, the doctor has the same X-ray vision that many have dreamed of since the days of "Superman". [15].

Along with education and training, virtual reality has taken its place in the treatment of some diseases. Mostly it is the treatment of psychological disorders, various phobias (fear of heights, spiders, darkness, etc.), post-traumatic stress disorder and so on. All these diseases are treated by a complex effect on the senses, which, in fact, characterizes virtual reality [15].

Creating works of art in virtual reality is a very popular topic that people are constantly talking about. Today, such an important question arises, and whether the creation of art in virtual reality will be the only way to see new art in a few years. Such transformations will significantly change the worldview.

Art is very important for humanity. From the very beginning of its existence, people have constantly created it in one form or another. From paintings on the walls to beautiful sculptures and graffiti. Today, people are increasingly interested in works of art. But even if you visit different art exhibitions every day for the rest of your life, seeing them all is an impossible task. Especially now, when most of the borders are closed, a person does not have the opportunity to personally see the works of famous artists. But this problem is solved by virtual reality. With the help of glasses, a person can visit the exhibition without leaving home. It has many benefits, saves money and time, allows everyone to immerse themselves in the atmosphere of art, even if this opportunity does not exist in real life.

The Google Arts & Culture platform is an online guide to museums and galleries around the world. At the time of its opening in 2011, it had collaborated with only 17 museums, reaching a total of 2,000 galleries, museums and palaces around the world. Each of the virtual museums includes high-quality digital collections of thousands of art exhibits, which are completely free to visit. The project is not only an online gallery, but also a set of useful tools that allow you to immerse yourself in the collection of each museum, sort works of art by type, period of creation, author's name and other criteria. The Google Arts & Culture art platform incorporates the best features of Google Photo and Google StreetView, as well as 360-degree panoramic videos that allow you to experience the special reality of what is happening on the screen. Among the interesting features of the application is Art Recognizer, the so-called Shazam for pictures, which helps to identify the picture in front of you; Art Selfie, which allows you to compare your own selfie with a catalog of many paintings to find possible matches [16].

In recent years, the concept of virtual educational environment, which occurs through the effective use of information and communication technologies in educational systems, is becoming increasingly popular. A prerequisite for the emergence of such an educational environment was the active use of virtual reality in the educational process. Remote access to information and educational resources ensures the continuity of the virtual world and promotes self-improvement and development of students [17].

Due to the pandemic caused by the COVID-19 virus, educational institutions have been forced to switch to distance learning, which has led to many inconveniences and problems, but these processes are being modernized and improved every day. Given this, we do not rule out the assumption that in the near future distance learning will occupy a major niche in the educational process.

According to the International Data Corporation, there are already about 200 universities in the world that deal with online technology to teach their students as seriously as traditional. The results are not long in coming. In the United States alone, 710,000 people underwent first-cycle higher education last year, or about 4.8 percent of the total number of 14,600,000 American students. In the future, the population of virtual students in the United States is expected to increase to 2,230,000 which should be 14.8% of the total number of students [18].

Through its interactivity, virtual reality provides students with a greater interest in learning the subject. For example, in biology lessons, thanks to BP, you can study plants from the inside, geography - to be anywhere in the world in seconds, astronomy - to travel through space.

Last year, the Polish company The Farm 51, which develops video games and programs for VR, released a unique virtual reality project about Chernobyl, which combines video games with an educational element. The company notes that VR is not only entertainment, but also important social topics, and therefore not only acquaints people with the history of the disaster, but also donates part of the money from the sale of the game to help victims [19].

In the military sphere, virtual reality is not something new, it has been used since the 1950s. BP is an effective, more reliable and cheaper way of all kinds of strategic military exercises. For example, training in anti-terrorist operations. To maintain their status, superpowers will invest heavily in the development of artificial intelligence and virtual reality capabilities, and competition in this area, according to entrepreneur and inventor Ilona Mask, could even lead to World War III [19].

In 1989, the military invented a helmet for The Super Cockpit aircraft, wearing it, the Boeing pilot was given information about the condition of the aircraft, speed, coordinates and other important parameters, which allowed not to be distracted by the control panel and helped maximum concentration of the pilot. Another important invention is the TRACER virtual military training kit, which consists of a VR headset, backpack and weapon simulation. Its development took into account the natural impact. There is also a virtual weapon, the company Striker VR, it mimics the real one in the process of use. With its use, soldiers feel its weight, recoil, and oscillations, which are inherent in real weapons [20].

The next classification feature is the sources.

Virtual reality can also be both an end product and a service. In fact, there are at least two examples of virtual reality as the end product in the city of Sumy - the virtual reality clubs Cube VR and Mr.VR. There are more and more such clubs all over the world because they are in demand. VR accessories and glasses also occupy an important niche in the market, the variety in price and quality indicates the availability of the product for different segments of the population.

More and more virtual content companies are competing in the services market. For example, Sensorama Studio, which specializes in the development of immersive technology applications, 3D modeling and 360 video creation for various areas of real estate, industry, education and culture; ADVin company, which specializes in three areas: AR, VR and 3D / 2D products; FlexReality, which also develops applications for iOS and Android in various areas of the gaming business, medicine, digital marketing, education, etc.

The third classification feature - by areas of use in business.

Increasingly, firms, corporations, in order to increase visibility and competitiveness, use VR in marketing strategy. With increasing competition in the market, there is a need to surprise the consumer. Good advertising and product visualization become an integral part of a successful company.

The New York Times was one of the first to use virtual reality in social advertising in 2015. The editor-in-chief, Jake Silverstein, concluded the same year that VR was the best format for telling the story of a remote or inaccessible place. Technology also helps to establish an empathic connection with the subject of history and to project what is happening to itself [23].

According to a study by StoryUP VR from Magnifyre, VR videos are liked by users 30% more than other formats. At the same time, the cost per 1,000 user interactions for this technology is lower - from $ 4.20 when using regular video, the price drops to $ 1.74. In addition, on average, twice as many users watch videos in the new format until the end. VR attracts viewers on an emotional level and not only encourages them to watch more, but also to empathize with what is happening on the screen, projecting situations on themselves or their loved ones [23].

And the last classification feature, the metauniverse.

The virtual world is gaining more and more popularity - virtual clothes, virtual games, virtual purchases, virtual money, virtual travels, etc. So, what is the Metauniverse?

The metaverse is a boundless, three-dimensional digital world that can be entered as easily as the Internet; in this world you can take a walk in the park, play games, go to a concert or get bored at work meetings [24].

Figure 2. Virtual clothing DressX.

The American programmer and entrepreneur, the founder of Facebook, is convinced that the future lies in the metaverse. Video games are the closest kind of meta universe. But Zuckerberg hopes that visitors will use virtual reality goggles to enter the metaverse. In September 2020, the price of glasses reached half of their original price, but this is not enough for the metaworld to come into mass use [24].

Equally known as Zuckerberg, Nike is also taking its first steps toward the metaverse. Nike plans to produce and sell virtual sneakers and clothing under its own brand. The company has submitted seven applications for trademark registration to enter the metaverse.

DressX company is known for the production and sale of virtual clothing. The great advantage of digital fashion is that it, unlike real fashion, operates on the concept of sustainable development.

The production and distribution of fibers and clothing used in fashion contribute to various forms of environmental pollution, including water, air and soil pollution. One of the main factors causing pollution is the huge overproduction and excessive consumption of fashion items and the use of synthetic fibers [25].

DressX creates the clothes of the future that eliminate waste and chemicals during production, as well as minimize the carbon footprint [25].

The production of digital clothing emits 97% less CO2 than the production of physical clothing. The company's calculations show that no water is used during production. Thus, the production of digital clothing saves an average of 3,300 liters of water per product, which is enough for one person to drink 2 liters a day for 3.5 years [25].

Conclusions and prospects for further research.

Thus, this paper forms a classification of virtual reality in the socio-economic spheres and analyzes in detail each area, namely: business, entertainment, health, art, education and military-industrial complex. Virtual reality is rapidly evolving in the socio-economic spheres, especially in a pandemic. Therefore, there is now a need for information and research on this topic. This article is the basis for further research on the classification of VR.

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Класифікація процесів віртуалізації соціально-економічних систем

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Актуальність роботи аргументована пришвидшенням темпу діджиталізації у зв'язку з пандемією COVID-19, адаптацією суспільства до умов дистанційного способу життя. В час віртуальних зустрічей та конференцій, дистанційної освіти, онлайн бізнесу напрямок VR технологій отримав швидкий розвиток. Роль VR у візуалізації комерційної та творчої галузі розвитку стрімко зростає, провідні гіганти частіше використовують технологію віртуальної реальності за для привертання уваги до свого продукту. У статті досліджено та класифіковано структуру VR технологій у сучасному світі, зокрема проаналізовано вплив на розвиток культури, процес навчання та охорони здоров'я, завдяки створенню нового апаратного та програмного забезпечення в напрямку досліджуваної теми. Описано інноваційні підходи до діагностики та

лікування певних хвороб людини, процесу навчання та відточування навичок лікарями за допомогою новітнього обладнання с технологіями доповненої реальності. Проаналізовано та систематизовано класифікаційні ознаки використання технологій VR за сферою використання, джерелом виникнення, способами використання у бізнесі та за ефектами, які отримуються. Продемонстровано розвиток віртуалізації у сфері бізнесу за останні роки, досліджено впив використання VR технологій на збільшення прибутку компаній. Завдяки VR у візуалізації комерційної стратегії бренду одягу, вдалося покращити число замовлень, змінивши концепцію показу мод, а саме прибравши моделей для одягу, що дало змогу концентруватися лише на товарі. Приведено розрахунок фінансових витрат при використанні VR для бізнесу у порівняні зі звичайними способами маркетингу, досліджено впив інноваційних технологій візуалізації на збільшення прибутку компаній. Описано вплив технології на економічний, технологічний та соціальний напрямок в сферах бізнесу, розваг, охорони здоров'я, мистецтва, освіти та військово-промислового комплексу.

Ключові слова: доповнена реальність, цифрова ера, метавсесвіт, віртуальна реальність, візуалізація, віртуалізація

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