Implementation of Augmented Reality Technologies in Artwork Creating Process

Tetiana Sovhyra[1]

Abstract

This article investigates the possibility of introducing and refining augmented reality (AR) technologies in the artwork creating process. In this context, the article examines cultural projects that AR technologies. The research methodology is a combination of several methods: analytical – for accounting for historical and fictional literature; theoretical and conceptual method – for analyzing the conceptual and terminological system of research and identifying the specifics of introducing the AR technology into cultural and artistic practice; comparative typological – for comparing AR and VR technologies, analyzing projects aimed at studying AI technologies and art interaction. The author has identified that in the process of creating augmented reality content, it is important to carefully link virtual models with the image of real space using markers. The author proves that the AR-compositions creation does not require significant financial resources and a large number of specialists. On the other hand, augmented reality technology provides significant advantages of viewing the necessary context: visualization, volumetric image, and interactive use of the necessary material. It has been established that virtual content can significantly change the content and ideological content of a work of art. Based on the marker image, a new artistic context is created and organized into an AR installation.

Keywords: Augmented reality, Digital technology, AR Installation, Virtual reality, Three-dimensional content.

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[1] Ph.D. in Art, senior lecturer, Dean of the Faculty of Arts, Kiev University of Culture, Kyiv National University of Culture and Arts. E-mail: STIsovgyra@gmail.com

Introduction

Digital technologies have long penetrated the art space and have significantly changed the genre and stylistic feature of the art of the 20th–21st centuries. Electronic music, computer graphics, web design were formed as a result of computer innovation and art synthesis. At the same time, in the era of technological progress in cultural and artistic practice, new creative experiments are constantly being carried out to introduce digital innovations into the process of artwork creating. There is a particular interest of cultural figures and engineering developers in the AR introduction into the field of art, the possibilities of using virtual and augmented reality in the process of creating a creative product.

According to analysts of Digi Capital, the revenue of the augmented and virtual reality industry has grown to $150 billion a year in recent years. At the same time, a significant part of these funds is allocated for the development of augmented reality devices – about $120 billion. Now the companies are working on the creation of an AR lens (Kreutzer & Sirrenberg, 2020). Many academic institutions such as the University of North Carolina, Massachusetts Institute of Technology, Columbia University, etc. as well as international companies such as Boeing, SONY, etc. are currently researching human-computer interaction methods, algorithms, and software and hardware platforms. In addition, augmented reality has been ranked among the top ten most promising technologies of the future by reputable organizations (Fan & Liang, 2012). Hence, the future promises seeing more interest in augmented reality technologies.

Literature Review

The use of technology in art has always been an urgent problem for scientific research, given the rapid development of the technological process and the introduction of technical innovations in all spheres of human life, including culture and art. This is evidenced by the array of topical publications. Special attention has been paid to the development of virtual and augmented reality technologies.

The first AR technology developments were carried out in the early 1990s by Louis Rosenberg at the Air Force Research Laboratory (AFRL), resulting in the pioneering Virtual Fixtures platform. A user wearing a special helmet saw a robot suit on (Rosenberg, 1993). According to the movements carried out with his own hand, the actions of the virtual robot changed. The sensors recorded the location of the user's body elements and instantly changed the real image to a virtual one. Thus, Virtual Fixtures were first organized by technology not virtual, but augmented reality.

Following Steuer (1992) and Rosenberg (1993), a critical review was conducted with the aim of analyzing researches that classified realities to reveal weaknesses, inconsistencies, or contradictions. This methodology highlights problems or disparities in the existing knowledge about VR and AR specifics. Q. Hongyan, W. Changbo, L. Junjun (2008), and Y. Chen et al. (2019) explain AR-content creating peculiarities and virtual objects and interconnection of real ones. A comparative analysis of the specifics of virtual and augmented reality was carried out in the studies of Van Krevelen and R. Poelman (2015), A. Joseph (2015), and C. Flavian, S. Ibanez-Sanchez, C. Orus (2019). Augmented reality (AR) is seen as a technology that combines virtual information with the real world (Chen & Wang, 2019).

Recent developments in the field of AR technologies are applied in several industries. In particular, in the commercial industry (Krevelen & Poelman, 2015; Bonetti, Warnaby, & Quinn 2018; Kerrebroeck, Brengman, & Willems, 2017), tourism (Griffin, 2017; Kulakoğlu-Dilek, Kızılırmak, & Dilek 2018),

education (Merchant et al., 2014; Joseph, 2015), healthcare (Freeman et al., 2017), entertainment (Lin, Wu, & Tao, 2017) and research (Fan & Liang, 2012; Flavian, Ibanez-Sanchez, & Orus, 2019).

At the same time, the issues of introducing technology in the cultural sphere remain unexplored. In the scientific literature, several publications were found that partially reveal the specifics of using AR for artistic purposes. Director of the Kiev Lavra Gallery T. Mironova (2020) analyzes the state of technology development and individual art installations in which AR is used in an experimental way. In her opinion, thanks to the latest technologies in contemporary art, new digital trends have emerged. I. Gardabkhadze (2019) studies the influence of augmented reality technologies on the formation of the fashion industry.

With the increase in the computing power of software and hardware, AR gradually moved from the stage of theoretical laboratory research to the stage of mass and industrial applications. A cross-platform environment for the development of computer games Unity developed by the American company Unity Technologies (2005) has now been created. With the help of Unity, the author creates virtual content and an application that is used for AR and VR installations.

Based on the results of a review of existing scientific and practical research, the issues of introducing augmented reality technologies into cultural practice are relevant. Despite their potential, the boundaries between different realities (virtual and augmented) have not been properly defined in the scientific literature. There is no consensus on how practitioners use these terms when designing and launching new devices. A review of the literature indicates that there is no fundamental study of the specifics of using AR technology in cultural and artistic practice and an analysis of the main characteristics of its functioning. This paper helps to fill this gap in the literature.

Purpose and importance of the article

The purpose of the research is to determine the possibility of introducing AR-technology specifics in the process of artwork creating. The purpose of this article is to analyze the state of development of augmented reality technology, the practice of its application in art space, and the possibility of creating artistic and technical experiments.

Methodology

In the study, the following research methods were used:

1) analytical method, by which the current literature had been analyzed;

2) theoretical and conceptual method, which made it possible to determine the conditions necessary for the implementation of AR-technology into cultural and artistic practice;

3) comparative-typological – for comparing AR and VR technologies, analyzing projects aimed at studying AI technologies and art interaction.

Discussion

AR technology is a kind of virtual reality, but it has excellent capabilities and significant (according to the author) advantages.

The principle of virtual reality assumes full immersion of the user in the created graphic world. The user puts on glasses (or a helmet with a built-in display), which broadcast a graphic image in accordance with its location in space. The position of the head is monitored using sensors built into the glasses (helmet), and the position of the hands is monitored using special gloves. VR is used for

various computer games and simulations, but outside of these areas, its application is very limited. In cultural and artistic practice, the use of VR technologies in immersive theater is observed, however, these cases are rare.

Unlike VR, augmented or enriched reality uses only a few virtual elements that are synthesized with the image of the real world. Therefore, in the scientific and publicistic literature, enriched reality is often called "mixed" reality. Augmented reality changes the current perception of the real-world environment, while virtual reality completely replaces the real user's environment with imitation (Steuer, 1992).

In the AR system, a video camera monitors the surrounding world, the image from which, after computer processing, is displayed on the monitor screen or glasses. The computer recognizes objects or special marks in the frame and adds a graphic image. In this case, the virtual part is not static, it is tied to the image of the surrounding world, which the computer continuously monitors according to the video camera signal (Mamontov, 2009).

Technical tools use multimedia, 3D modeling, real-time tracking and registration, smart interaction, sensing. Its principle is to apply computer-generated virtual information such as text, images, 3D models, music, video (Chen & Wang, 2019).

The principle of using AR-technology in the cultural sphere

The principle of using AR-technology in art is that the artist can use digital graphics to give static works of visual art dynamism and volume, as well as to synthesize a real image with a virtual one.

The viewer aims his gadget at a painting, sculpture, or a specific point in space and sees through the device screen images of art objects and graphic drawings. Digital virtual images are combined with physical reality, artwork from a static form turns into a dynamic, mobile, volumetric one. The screen of the gadget (phone, tablet) shows AR graphics and images, and is captured by the built-in camera. Thus, augmented reality and the environment can be synthesized on the same plane. The synthesis of images is carried out instantly on the screen, without additional manipulations. The viewer becomes a part of this story.

AR graphic model is created on the basis of the image label of the object world. In specialized computer programs and editors, certain coordinates are set and the image is analyzed, on the basis of which a three-dimensional model is created. Therefore, the image of augmented reality serves as an auxiliary means for creating an artistic composition.

Now augmented reality in cultural and artistic practice has already become a tool for accurate drawing and modeling of space. It is known that the first device for measuring proportionality and creating a realistic image was the Lucida camera (Ruesseler, 2006). Using a projection is possible to see the contours of objects and accurately paint them on canvas. With the advent of three-dimensional graphics, the idea arose of transferring volumetric models in virtual space, especially comparing virtual objects with real ones. This is especially true for spatial arts (architecture and environmental design). Mobile applications have already been created that allow using AR to proportionally accurately and realistically create any volumetric image. SketchAR allows the user to see a virtual image in real space. Artists often use this mobile app to create precise sketches of their designs. On the phone screen, the master sees the necessary virtual object in the right place in real space, puts paper on the screen, and defines the contours of the image with a pencil. This creates a proportionally accurate layout or sketch.

Authoring 3D-content and software applications for AR-installations

The author of the article proposes to consider the process of creating and presenting AR content using the example of our own graphic and software developments created for the presentation of an advertising booklet of the Department of Directing and Mass Holidays of the Kiev National University of Culture and Arts. The goal of the experiment is to visualize and give artistic form to the text of the document.

The author has developed a software application based on the Unity digital development platform, which allows you to view augmented reality compositions based on images from the pages of the booklet. This application can be downloaded for free on any gadget with the Microsoft Windows operating system.

The application launches the necessary audio sequence (music, reading the text), which allows the reader to explain the rules of use, pay attention to the main keywords and create the necessary solemn atmosphere. In this case, the user sees on the screen the image that the gadget's camera takes. When the lens of the gadget fixes the pre-programmed booklet page, the necessary graphic model appears on the screen of the gadget.

The page is the commit marker. At the moment, five markers have been created – five volumetric graphic compositions.

Picture 1. REMS, director T. Sovhyra, KNUKiM, 2020.

The booklet examines the disciplines that are taught at the department. Therefore, the author has created virtual graphic models of students, which are programmed to demonstrate the skills and abilities acquired in practical classes. Thus, the visualization of the educational process occurs.

The figures are three-dimensional and movable. They appear as soon as the gadget screen corrects the programmed page. The position of the marker changes – the 3D model moves accordingly. If you change the viewing angle, the model will expand too. If the user turns or closes the page, the 3D model will disappear.

Another example: on the sixth page of the booklet, dedicated to the specifics of students' work on the stage, the author has created a graphic text model "REMS is the Cosmos" and placed several planets in a visual perspective. The idea of creating this composition is to show the viewer in an artistic allegorical form the endless possibilities of the department to provide students with practical experience on stage.

The example of the last AR-installation shows that the virtual composition is conceptually different from the real one depicted on the brochure page. This means that through augmented reality, you can change the meaning of reality and give it the necessary directorial subtext.

These results of the author's practical research led to the need to consider other implemented examples of technologies used in cultural projects in order to study the specifics of the interaction of the AR model with the image of reality (marker).

Principles of using artworks in AR-content creation

Computer industry experts use mock-ups of famous artifacts, pictures of paintings, photographs to create AR content. An example is the Mona Lisa project created by Mats Gunnarsson.

The famous work of Leonardo da Vinci "Mona Lisa" is considered an intact artwork, kept in the Louvre. However, thanks to the AR application, it becomes possible not only to save images of the masterpiece in the phone but also to edit it yourself. The user can try on the Mona Lisa's face. In this case, the marker is the face of the user who, by changing facial expressions, edits the images on the screen. The Mona Lisa is used as a graphic model. Now it is possible to edit the faces and change the emotions of the Mona Lisa with your own hands.

Picture 2. Examples of using the "Mona Lisa AR" application.

A similar principle of using artworks as a graphic series for AR applications is observed in the visual works exhibition ReBlink (2017), which was founded by AGO and digital artist Alex Mayhew.

Gallery visitors, using phones or tablets, can see how objects on famous canvases come to life. The face on the canvas suddenly starts to move, a modern device appears in her hands (a laptop, phone, or a cup of coffee with the logo of a famous restaurant). On the screen of the gadget, you can see how an astronaut appears at the picture or music begins to play. Thus, the authors of the project not only demonstrate the capabilities of digital technologies but also express their own attitude towards the used artifacts.

For example, on the canvas "Drawing Lots" by Canadian artist George Agnew Reid (1888-1992), you can see three friendly characters overseeing the development of a board game.

Picture 3. "Drawing Lots", The Art Gallery of Ontario, Toronto.

Pointing the gadget at the picture, the viewer notices that the image is changing on the screen. Three guys disperse in different directions, holding mobile phones in their hands. The idea of the author of the exposition is to compare the choice of entertainment and recreation of people of different eras and to show the significant influence of gadgets on relationships and communication between them.

Through AR technology, a new digital art form AR-installation is created. The visual and expressive means are digital volumetric graphics.

Based on the foregoing, it becomes clear that the virtual content created in relation to the author's idea is an artistic overtonation of this experiment, carries a meaningful component different from the original source, artistic significance.

Specificity of AR installations creating

The collection of visual and technical experiments "Mirages & Miracles" by French digital artists Claire Bardeen and Adrian Mondo testifies to the possibility of augmented reality technology to create unique digital content organized into an art form – an AR installation. The collection consists of several exhibits that, at first glance, have no meaningful content.

The viewer sees a stone on white paper and nothing more. Pointing a gadget (phone, tablet computer) at the exhibit, he observes the action of graphic objects that have appeared on the screen. Instantly, a silhouette of a man jumping over stones appears on the screen. The viewer involuntarily observes the actions of the virtual personality. He can change angles, edit the scale of the image, moving around the exhibit. The viewer can walk around the stone: the image of a person on the screen is three-dimensional and viewed from all sides. In this case, the user's gadget is the motion sensor.

The virtual silhouette moves and performs certain manipulations. It is programmed to create a certain graphic pattern and find itself in the necessary coordinates (in this case, on a stone). Thus, the exhibit turns into a visual-spatial installation organized using augmented reality technology.

All works are thematically and stylistically interrelated, represent separate episodes of the general concept of the project. Each composition is created using augmented reality technology, due to which the details seem to "come to life" and fill with content. Without using this technology, installations incomprehensible to the viewer and meaningfully empty.

Explore the Mirages & Miracles exhibits with/without AR-technology:
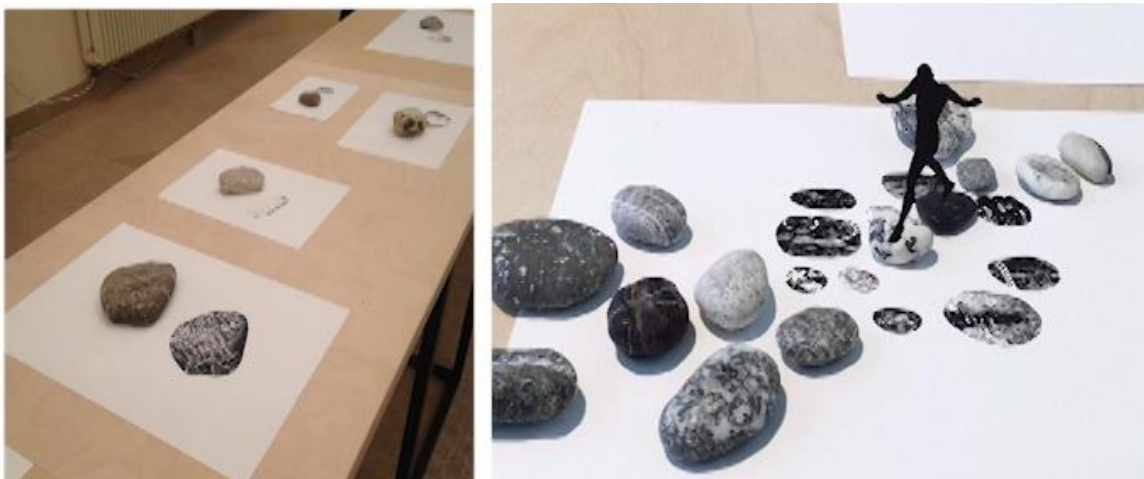
Picture 4. The Mirages & Miracles installation without using AR-technology / Installation using AR-technology

The example of this installation shows that digital technology makes it possible to create artworks in virtual form. Thus, AR can be seen as a technology through which an artistic product is created.

AR installations are not only installed in galleries and exhibition halls. Augmented reality technology is widely used to bring street art to life, bringing its message to a wider audience. This means that passers-by no longer need to guess the meaning of visual street art, but instead, they can stop and watch its plot using their gadgets.

AR street art is used for advertising posters, commercial presentations, and artistic visual installations. The implementation condition must be the presence of a marker – an object for which a graphic model appears. This can be an image of the facade of a building, a monument, a detail of a building, a store, a banner, etc. For example: interesting AR works were created by the American artist, sculptor, and designer KAWS in different cities of the world and the Korean artist Ku Jong Ah (Regent's Park, London).

Picture 5. KAWS, Companion (Expanded), Paris, 2020.

Results

On the example of the author's development of content for AR-installations it is found out that in the process of creating augmented reality content, it is important to thoroughly link virtual models with the image of real space using markers. Augmented reality technology involves the use of multimedia, 3D modeling, tracking and registration in real-time, intelligent interaction, sensing. Its principle is to use computer-generated virtual information such as text, images, 3D models, music, videos.

The author shows that creating AR compositions does not require spending significant financial resources and having a large number of specialists. On the other hand, augmented reality technology provides significant advantages of viewing the required context: visualization, volumetric image, interactive use of the necessary material.

Conclusions

The study revealed the features of the AR-technology functioning in cultural and artistic practice. Models of famous artifacts, paintings, photographs are used to create AR content. The examples are the Mona Lisa and ReBlink projects. Using digital graphics in the AR application, it is possible to give dynamic and three-dimensional images to static works of visual art, to synthesize a real image with a virtual one. It has been established that virtual content can significantly change the content and ideological content of artwork. Based on the marker image, a new artistic context is created, organized into an AR installation. In the artistic process, AR can serve as a digital means of expressing a director's idea.

As a result of the analysis of scientific works, existing practices, and the author's own developments for creating augmented reality content, it was found that this technology can be used in artworks creating processes to give artistic imagery, volume, and dynamics to the image.

Based on the foregoing, it becomes clear that the virtual content created in relation to the author's idea is an artistic overtonation of this experiment, carries a meaningful component different from the original source, artistic significance. An analysis of the current state of development of AR technologies indicates significant prospects for the development of technologies and the need for further analysis of the best practices of using augmented reality in cultural and artistic practice.

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