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**SPECIFICITY OF AUDIOVISUAL CULTURE IN MULTIMEDIA SPACE:
SOUND ASPECT**

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The purpose of the study is to identify the basic key properties of sound in audiovisual culture in a multimedia space, to determine how sound influences on the formation of this phenomenon. Methodology of the research. There were the scientific methods such as diachronic (presentation of the historical development of means for creating audio for a multimedia project), comparative (comparison and search of common and distinctive features in different properties and manifestations of audiovisual works in multimedia), analysis and synthesis (disclosure of separate components of audiovisual culture in the multimedia space, in particular audio, its characteristics related to multimedia, and the synthesis of the phenomenon from the positions of reached results) to accomplish the article purposes. Scientific novelty. The article presents a new view on the definition of the concepts of a multimedia product as a digital file that determines the specificity of working with it, the multimedia space as a set of computer tools and projects that combine several types of data such as text, graphics, video, sound, etc. The use of sound in multimedia products, the influence of the work features with sound on the artistic component of the multimedia product and on the audiovisual culture in general have been analyzed in a new way. Conclusions. The work outlines the general characteristics of audiovisual culture of the multimedia space. In particular, various types of multimedia works have been identified; their features, which are related to their nature – that is, a complex synthesis of the types of information available in the projects, have been given. The aesthetic component of multimedia space, transformed due to specific artistic and technological dynamics, in particular the emergence of new examples of audiovisual content in multimedia space, has been analyzed. The main stages of the development of methods and tools for creating background in multimedia are described. The basic characteristics of sound and its role in the audiovisual culture works in the multimedia are shown.

Keywords: audiovisual culture; sound; multimedia space; Internet; multimedia project; audiovisual works.

Introduction

Audiovisual culture is an important sphere of the life of modern society. In a more narrow sense, this term includes the phenomena associated with cinematography, television and screen products that have similar qualities, but

exist in other, electronic digital media, for example, in media (Internet, etc.). The impact of this phenomenon on a person is significant, as is the importance of using sound in audiovisual culture in the multimedia space. This subject is relevant and should be considered separately.

The use of sound in multimedia works is a multifaceted question, and researchers in different sciences study this issue from various points. Some data on the characteristics of sound in a digital environment can be found in the publications “Digital Audio and Video Processing in Multimedia Systems” (Oleksenko, 2014), “Electronic and Computer Music” (Manning, 2013). The last publication also describes the evolution of means of creating sound in a digital environment, which is the basis for multimedia from the standpoint of music in preference to audiovisual culture. Ukrainian researchers and expert sound directors analyze the use of sound in movies in their publications, but the issue of sound art in multimedia is not being studied (Barba, 2016; Papchenko, 2018; Ryazantsev, 2015). Therefore, it is worth focusing on the study of this issue.

The purpose of the article

The main objective is to reveal the essential characteristics of sound as a component of audiovisual culture in the multimedia, to determine the role of sound for the formation and development of audiovisual culture in the context of multimedia.

To achieve the objective of article it should be focused on the following *tasks*:

- to consider the basic characteristics of sound in multimedia;
- to study the evolution of systems for working with sound in multimedia and their influence on art sound options;
- analyze transformational processes in audiovisual culture into multimedia.

Presentation of the main material

Since multimedia technologies exist in computer systems, all the features of creating, storing and reproducing multimedia products are based on the digital data origins.

Any multimedia project is a digital file, a certain part of the digital storage medium, and contains the information in binary form. Each file that contains multimedia data has a format – a way of organizing data in the file, capabilities and limitations of the processes for recording, storing and playing specific types of data.

The concept of multimedia space should be also defined. There are computer tools and works that use a combination of different data forms such as text, graphics, video, sound, etc.

Multimedia works are complex synthesis by time characteristics, as a single project, for example, Internet pages at the same time can be a source of space, time, and synthetic types of information. Since the subject of this work is

the formation of audiovisual culture, we will focus more on such multimedia works and their components that are expanding in time.

By way of transmitting to the viewer, the multimedia products can be divided into linear and non-linear. Linear multimedia is such products, the content of which is transmitted sequentially and in real time. Examples include online broadcasting, conferencing, video-on-demand viewing, and more. Of course, due to the capabilities of multimedia, some of these works provide the user the ability to stop viewing, navigate to any point of the work (or a typical option for the broadcasts – to any previous point). Such works can be stored in a file on the user's device, may be available continuously online, or only when transmitting such linear content.

Non-linear multimedia products are transmitted to the viewer in the form of a finished file (or a group of files) or information medium that contains this product. Thus, non-linear multimedia is most often available through download from the server or on CDs and other physical carriers.

In any case, when viewing multimedia products that are expanded in time, the viewer will face digital video, audio, and animation. Therefore, this section will discuss the features of saving and viewing (broadcasting) these types of data.

First, we consider the specifics of digital audio. Digital audio sources can be either ADC (analog-to-digital converter), which convert an electrical signal to a digital code, or a computer program generating digital sound (for example, a virtual synthesizer). Main features of digital sound are sampling frequency, quantization bit rate, presence and characterization of digital audio compression method.

The main difference between the digital and the analogue audio, which determines the set of its options, is a discrete nature, that is, one that consists of sequential numerical values (discretely). Instead, the analog audio signal is a continuous change in voltage over time. The process of transforming a continuous electric signal into a sequence of samples over a period is called sampling or discretization. Sampling rate is the number of samples (discretely) per second.

It is important to note how exactly the desired sampling frequency is selected. Timbral quality of digital audio (or rather the maximum allowable upper frequency in the spectrum of the signal) depends on the frequency of sampling, that is, described by Nyquist-Shannon-Kotelnikov sampling theorem, which states that the sampling frequency should be at least twice as much as the upper frequency in range. That is, if the upper frequency is 20 kilohertz, then the sampling rate should be at least 40 kHz (CD audio standard is 44.1 kHz). If you do not observe this law, then, from the frequency of the signal spectrum, which is equal to half of the sampling frequency, distortion of sound may be heard. Such a phenomenon is called aliasing.

The quantization of a signal is inseparable from discretization, since a certain number must represent the values of the amplitude of each count. "The digital signal is finite state by the set of its values. The process of transforming analogue discrete infinite by their values for a finite number of digital values is

called quantization by level, and occurring during quantization errors of counts rounding refers to as noise or quantization errors” (Oleksenko, 2014, p.20). To perform this process, the analog signal range is broken down at the quantization levels, the number of which is fixed and determined by the bit depth, that is, the number of digits of the binary code, which can represent the amplitude of each count-discretion. For an example, we take two-bit depths: 8 and 16 bits. The first can contain 256 (2^8) different numeric values, and the second one is 65536 (2^{16}). So, as we see quantization at a higher bit rate give a possibility to express the real (or probable – in case of digital sound generation) value of the sound signal more accurately. This characteristic is also called quantization resolution.

The use of a certain compression of digital sound also affects or does not entirely on its qualitative characteristics. The standard for professional digital sound recording is pulse-code modulation that does not use compression. This is the above-mentioned method for translating analogue sound into digital (by quantization of samples amplitude – discretely – that are arranged through the same time interval). The compression process itself involves reducing the amount of digital audio information. For this purpose, two ways are more often used: the rejection of such parts of information that do not significantly affect the quality of listening (for example, mp3-compression), or the selection of complex mathematical functions that are similar to certain segments of sound (FLAC-compression). This makes it possible to distinguish between lossy and lossless compression, respectively.

Since the compressed digital sound has a different structure, unlike the uncompressed one and does not always contain separate samples, then for such files the bit rate becomes important as opposed to the sampling frequency and bit quantization. Bit rate is the amount of information in bits per unit of time. So the higher the bit rate, the more audio information contains the audio file, the better the sound could be.

In the process of evolution of multimedia the systems for creating and editing video material was being actively developed, in particular, developers actively involved digital technologies for the introduction of new creative tools. In parallel with the emergence of tools for working with video also multimedia tools for recording and editing sound was created. Such instruments gradually increased the ability of sound engineers to engage in artistic interaction with audio material.

SoundDroid was one of the first systems for digital audio based on a computer that used visualization of certain actions on the display. This is the development of the Lucasfilm studio, which appeared in the mid-1980s in parallel with the EditDroid video editing system. The base of the SoundDroid station was a digital processor that was able to process real-time audio. One of the fundamentally new features of this technology was the storage of digital audio on hard drives. With this build, one could search for effects in the sounds library. It should also be noted that on the screens of the editor was visually represented audio wave (M. Kunkes). Using SoundDroid, the sound engineer was able to conduct a complete cycle of works on the creation of a phonogram: recording, editing, processing, mixing. Internal software modules also allowed

synthesizing sound, multichannel frequency processing, reducing unnecessary noise, adding digital reverb. Another important point in the list of the benefits of SoundDroid is that the station included a set of innovative multimedia tools with which the sound engineer was able to control it: touch screens, moving faders and scrolling wheel (Tracy, 1985).

The next major step in the development of digital audio editing technology was the introduction of a personal computer and specific operating systems. In this case, the audio station consisted of an analog-to-digital (ADC) and digital-to-analog converters (DAC), software that was created for a particular computer, namely the configuration of hardware (processor, built-in data storages and drives for external media connection, graphics controller and its capabilities, etc.) and the installed operating system. That is, unlike SoundDroid, the audio stations that were created for the personal computer did not have a built-in microprocessor and an operating system that would manage the processes associated with the functioning of the hardware. Instead, as already mentioned above, digital audio editing applications were developed for work in pre-configured sets of specific equipment and operating systems. The new approach has its advantages and disadvantages. Among the advantages, it should be possible for sound applications developers to focus on those functions that were related only to audio.

So, Sound Designer, the first audio software on the personal computer, was introduced in 1985 by the Digidesign Company, which is now known for Pro Tools, the professional digital audio workstation. Sound Designer was an application for editing samples on the Apple Mac platform. Sample is a small segment of recorded audio (usually from 0.5 to 2 seconds, but also it could be with another duration), which is usually processed in music production (length variation, frequency correction, etc.) in order to further use to create a composition. Examples include the sound of a percussion instrument, a musical chord, a small part of melody, an acoustic effect (glass breaking, sea noise, bird singing), etc. Samplers are loaded into a sampler, that is, a device or a program for controlling audio bits, which also provides the user with the ability to process and play sounds (usually at different pitches, controlled by an electronic keypad or a pitch shifting wheel).

Therefore, the Sound Designer included reading, editing, processing and recording of modified audio samples on a digital media. Initially, the sound editing system was created only to work with the sound base of one specific sampler, but the distribution of these tools among musicians and the availability of different models of samplers by many manufacturers has caused the authors to add support for other most popular devices, which greatly expanded the audience of users of the application. It should also be noted that the sound station worked only with monophonic audio, but used a 16-bit quantization.

We look at the list of basic tools for working with audio in the Sound Designer program. First, it is important to note that the system was designed in such a way that all processes were presented visually, that is, the user worked precisely with a graphical representation of the sound wave. Therefore, the sample editing could be done by cutting, copying and pasting the selected parts

of the audio file. Reverse (mirroring), automatic crossfade creation at cutting and insertion parts of the sound were also available. Among the means of processing there were the change in sound level, frequency correction, free transformation of audio wave using a graphic tool (drawing), etc. There was an important tool – a digital dramatic control unit, which allowed mixing two different samples, setting their proportions in the new file. In addition, the application contained a digital synthesis tool for creating new sounds (Gotcher, 1986).

In the evolution of software for digital editing, audio developers faced with the fact that central processors of personal computers could not either carry out all calculations for digital sound processing, or carried them very slowly. This led to the redirection the load of sound-related processes on separate digital signal processors (DSPs), which were located on special sound cards that were intended for installation in the middle of the system unit of the personal computer. This approach has greatly reduced the number of tasks for central processors and the amount of time that digital audio stations typically spend on audio processing.

A similar method was used in 1989 by the Digidesign organization for its other product – the Sound Tools complex, which was designed for digital recording and audio installation on a personal computer. The system came with a new version of the previously described Sound Designer application, an acceleration card for sound processing (which was based on the processor for digital signals – DSP – and a digital-to-analog converter) and an external device containing an analog-to-digital converter. Using this station, it was possible to record and work with stereo (dual-channel audio) at the level of CD-Audio quality, that is, with a sampling rate of 44.1 kHz and a bit depth of 16 bits. These characteristics made it possible to use a complex for rewriting the combined phonogram in stereo and carry out mastering (final processing of the finished mix). Describing the benefits of the new software, P. Manning observes that processing could be done in real time: adjusting the parameters of the processing modules did not affect the file itself, but only changed the sound during the listening. The author also mentions some available software tools: a 10-band graphic equalizer, means for stretching or compressing time of a file and overlaying curves of smooth appearance – fade-in and fade-out (Manning, 2013, p.387).

Further, in 1991, the same company Digidesign created Pro Tools – a sound station for a personal computer that gradually began to attract more and more attention to such digital recording and audio editing systems from the side of large studios. The main advantage of this development was the expansion of the number of channels available for sound channels (at that time there were 4 channels), which translated the complex into the category of multichannel systems.

The development of similar multimedia workstations has changed the way of phonogram production, due to the subsequent emergence of complete sound-assembly complexes that are concentrated in one personal computer and allow one to create audio on a professional level. As a result, to date, full-fledged digital sound systems for mobile devices (MAW – mobile audio workstation) have appeared. In addition, online sound services have become an interesting

trend, which already combine multichannel recording, real-time processing, MIDI and synthesizer work, and more. It should be noted that the entire process of development of instruments for producing sound in the multimedia space has significantly influenced the art qualities of audio backing: accuracy with which it is possible to edit and correct sound, the accuracy of setting up artistic sound processing devices, the ability to flexibly change the sound solution have increased – all these factors have considerably expanded artistic instruments of a modern sound engineer working on the creation of audio-visual works.

Flexibility and ease of programs for work with video and audio caused the transition of audiovisual production to a greater focus on the installation-tinting period (post-production). This leads to a change in the aesthetics of works, as new tools expand and in some ways determine the new methods for achieving creative tasks.

Due to such dynamics during the last decade, aesthetic content of multimedia space has noticeably changed. The role of the cinema became more noticeable. The number of cinema works that are available through the Internet and multimedia devices has increased dramatically.

In the late 1990s and early 2000s, technology for online video transmission, Internet broadcasting began to be actively developed. One of the prominent projects that embodied the new method of multimedia viewing was the BMW advertising campaign. According to American researcher James Castonguay, in 2001, the organization released a series of eight short online commercials with the common name “The Hire” (J. Castonguay). Recognized directors such as David Fincher, John Frankenheimer, Guy Ritchie, Alejandro Gonzalez Inarritu, and others produced the films. There were also invited stars such as Clive Owen, Stellan Skarsgard, Madonna, Forest Whitaker and Gary Oldman. The company later provided statistical data, which indicated that videos were watched more than 100 million times before they were removed from the site in 2005, despite the fact that the films were released on DVD in 2003 (J. Castonguay).

However, on the way to introducing online hosting services top the technical and infrastructural barriers related to bandwidth and quality and video size could be overcome. The Internet copyrighting, Internet hire, and the insertion into the system of film releases on different media (which traditionally begins with cinemas, then video/DVDs, paid one-time viewing, paid cable channels, television network, etc.) are complicated process of the distribution of cinema on the Internet. For example, as it is said in the article, large copyright holders (i.e. Hollywood studios and entertainment conglomerates) prevented companies such as Netflix from switching from their old rental methods to streaming video on demand and downloading over the Internet, although online rental services of DVD discs and delivery them by mail in the mid-2000s was one of the top-grossing web enterprises (J. Castonguay).

After the big film companies have been considering economic and legal issues, (it was important that film producers generated the most of their incomes not from public cinemas, but from home cinema), the development of projects of distribution movies through the Internet has begun. One of the options for such a rental is a website with available download or paid viewing of

full-length films that have already been released for sale on DVD. An example of companies that worked this way – MovieLink, CinemaNow (they functioned as a joint venture between major film studios such as Sony, Warner Bros., etc.). The next example of distributing moving pictures through multimedia systems was Apple Computer’s decision to distribute animated short films from Pixar, Disney–ABC television programs and music videos via iTunes (an online music download service) (J. Castonguay).

New art forms, that combine multimedia and cinematic approaches and the production of which has become possible for the wide audience through multimedia technologies, have emerged. Bright examples of this synthesis are web documentaries, various interactive audiovisual products, transmedia projects, etc. Sound in multimedia space also gets new uses. Firstly, in such an environment it is much easier to distribute and review the works with the spatial sound of different formats, as well as to choose the tracks by user, which one would like to turn off or on. Secondly, the sound in the multimedia space may be interactive, that is, responding and guided by user actions. As far as spatial sound is concerned, it is worth noting that the Netflix video-on-demand video streaming platform already has many movies that the viewer can view using spatial sound systems, while another video platform – YouTube – did not implement such a function for the widest audience.

The scientific novelty of this publication is to clarify the definition of such concepts as multimedia product, multimedia space, taking into account their digital and computer origin. In addition, in the research we treated the issues of the formation of audiovisual culture in the multimedia space and the role of sound in this process, in particular the opportunities that arise for using sound in a new environment.

Conclusions

The article is devoted to audiovisual works in multimedia space, their main characteristics, evolution of means of projects creation. Most issues are considered from the standpoint of sound and its role in these processes. The publication analyzes the basic features of multimedia works, their types, and the characteristics of sound in the multimedia space. In addition, the article investigates the evolution of the means of creating sound within the limits of digital multimedia audiovisual works and their significance for the creative side of the soundtrack. The process of formation of audiovisual culture in multimedia and its current state is highlighted.

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СПЕЦИФІКА АУДІОВІЗУАЛЬНОЇ КУЛЬТУРИ В МУЛЬТИМЕДІЙНОМУ ПРОСТОРИ: ЗВУКОВИЙ АСПЕКТ

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Мета статті – виявити основні сутнісні властивості звуку в аудіовізуальній культурі в мультимедійному просторі, визначити вплив звуку на формування цього явища. Методологія дослідження. Для виконання завдань, що поставлені в цій статті були використані такі наукові методи, як діахронний (виклад історичного розвитку засобів створення звукового супроводу для мультимедійного твору), порівняльний (зіставлення та пошук спільних і відмінних рис у різних властивостях та проявах аудіовізуальних творів в мультимедіа), аналіз і синтез (розкриття окремих складників аудіовізуальної культури в мультимедійному просторі, зокрема звукового супроводу, його характеристик, пов'язаних з мультимедіа, та синтез явища з позицій досягнутих результатів). Наукова новизна. У статті представлено новий погляд на визначення понять мультимедійного твору як цифрового файлу, що зумовлює специфіку роботи з ним, мультимедійного простору як сукупності комп'ютерних засобів та творів, які поєднують декілька видів даних: текст, графіку, відео, звук та ін. У новому аспекті проаналізовано використання звуку в мультимедійних творах, вплив особливостей роботи зі звуком на художній складник мультимедійного твору та на аудіовізуальну культуру загалом. Висновки. У роботі висвітлені загальні характеристики аудіовізуальної культури в мультимедійному просторі. Зокрема, визначені різні типи мультимедійних творів, виокремлено їх особливості, пов'язані з їхньою природою – складним синтезом видів інформації, присутніх у творах. Проаналізовано естетичне наповнення мультимедійного простору, що трансформувалося завдяки специфічній мистецькій та технологічній динаміці, зокрема поява нових зразків аудіовізуального контенту в мультимедіа-просторі. Викладені основні етапи розвитку методів та інструментів створення звукового супроводу в мультимедіа. Продемонстровані основні характеристики звуку та його роль у творах аудіовізуальної культури в мультимедійному просторі.

Ключові слова: аудіовізуальна культура; звук; мультимедійний простір; Інтернет; мультимедійний твір; аудіовізуальний твір.

СПЕЦИФИКА АУДИОВИЗУАЛЬНОЙ КУЛЬТУРЫ В МУЛЬТИМЕДИЙНОМ ПРОСТРАНСТВЕ: ЗВУКОВОЙ АСПЕКТ

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Цель статьи – выявить основные важные свойства звука в аудиовизуальной культуре в мультимедийном пространстве, определить влияние звука на формирование этого явления. Методология исследования. Для выполнения заданий, поставленных в этой статье были использованы такие научные методы, как диахронный (изложение исторического развития средств создания звукового сопровождения для мультимедийного произведения), сравнительный (сравнение и поиск общих и отличительных качеств в различных свойствах и проявлениях аудиовизуальных произведений в мультимедиа), анализ и синтез (раскрытие отдельных составляющих аудиовизуальной культуры в мультимедийном пространстве, в частности звукового сопровождения, его характеристик, связанных с мультимедиа, и синтез явления с позиций достигнутых результатов). Научная новизна. В статье представлен новый взгляд на определение понятий мультимедийного произведения как цифрового файла, что обуславливает специфику работы с ним, мультимедийного пространства как совокупности компьютерных средств и произведений, которые сочетают несколько видов данных: текст, графику, видео, звук и др. В новом ключе осуществлен анализ использования звука в мультимедийных произведениях, влияние особенностей работы со звуком на художественную составляющую мультимедийного произведения и на аудиовизуальную культуру в целом. Выводы. В работе освещены общие характеристики аудиовизуальной культуры в мультимедийном пространстве. В частности, определены различные типы мультимедийных произведений, приведены их особенности, связанные с их природой – сложным синтезом видов информации, имеющихся в произведениях. Проанализировано эстетическое наполнение мультимедийного пространства, которое трансформировалось благодаря специфической художественной и технологической динамике, в частности появление новых образцов аудиовизуального контента в мультимедиа-пространстве. Изложены основные этапы развития методов и инструментов создания звукового сопровождения в мультимедиа. Продемонстрированы основные характеристики звука и его роль в произведениях аудиовизуальной культуры в мультимедийном пространстве.

Ключевые слова: аудиовизуальная культура; звук, мультимедийное пространство; Интернет; мультимедийное произведение; аудиовизуальное произведение.