



NEW BULGARIAN UNIVERSITY

MUSIC DEPARTMENT

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**ELECTRONIC SOUND DESIGN AND ITS
APPLICATIONS IN DJING**

AUTHOR'S ABSTRACT

for

DISSERTATION

for awarding the educational and scientific degree

"Doctor"

Professional field: 08.03. Music and Dance Art

Research supervisor:

Prof. Dr. Simo Leonov LAZAROV

Sofia, 2022

The dissertation was discussed and admitted for the defense at an extended meeting of, held on

The dissertation consists of an introduction, five chapters, a conclusion, an account of the contributions of this work, a bibliography, two appendices, a list and location of figures, and a list and location of tables. The text constitutes 333 pages.

The literature cited includes 227 titles, of which: 42 titles are in Cyrillic alphabet, namely in Bulgarian and Russian; 6 titles are in Latin alphabet, namely in English, 3 titles are electronic documents, and 180 titles are Internet-based sources.

The list of figures includes 158 items, the list of tables is comprised of 13 items. Their location in the dissertation is also given.

The dissertation defense will take place on from till
at a public meeting of the Scientific Jury under Order No. 3-PK-248/27.05.2022 composed of:

1. Assoc. prof. Dr. Rositsa Dimitrova Becheva, NBU, professional field 8.3.

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Author: **Teodor Todorov Popov**

Title: **ELECTRONIC SOUND DESIGN AND ITS APPLICATIONS IN DJING**

GENERAL CHARACTERIZATION OF THE DISSERTATION

INTRODUCTION

Electronic sound design is the expression and result of creative activity involving sound and its media aimed at creating and modeling sound spaces. Thanks to the possibilities of the applied equipment, sound recording, and sound processing allow very accurate sound reproduction, high-quality sound modeling, as well as the creation of new and unusual sound elements to achieve a certain effect and meaning.

DJing is one of the newly established forms of sound art, which emerge due to and rely to the maximum extent on scientific and technical discoveries and innovations, reflecting and utilizing their development over the recent years. The electronic sound design applied in DJing is related to artistic musical endeavors and the creation of aesthetic sound perceptions. It saturates the space with unique sound images and pictures. Through it, the DJ shapes the sound environment and the sound space emotionally using various technical abilities and methods.

The DJ is the new kind of musician, who employs technical and technological advances and innovations to use and create music with a new aesthetically impactful design.

RELEVANCE OF THE TOPIC

The relevance of the dissertation research on electronic sound design and its applications in DJing stems from:

- the rapid advance of innovations in technical equipment and technology and the extent of their implementation in the musical arts;
- the current state of the problem and the insufficient number of scientific studies in this field.

THE STATE OF PRIOR RESEARCH IN THE FIELD

Among scholars well known for their work and publications related to electronic sound design, one can name the British researchers Tony Gibbs (*The Fundamentals of Sonic Art & Sound Design*), Carl John Boland (*A Sonic arts approach to Sound design*), and Leigh Landy (*Making Music With Sounds*) as well as Prof. Dr. Simo Lazarov (*Electronic Music and Synthesizers*) from Bulgaria.

Some aspects of DJing are reviewed in the research and publications of such specialists as Bill Brewster and Frank Broughton (*Last night a DJ saved my life: the history of the disc jockey*); Asa Briggs (*The history of broadcasting in the United Kingdom*), Rob Chapman (*Selling the sixties: the pirates and pop music radio*), Ulf Poschardt (*DJ Culture*), Arnold Passman (*The deejays*), Laurent Garnier and David Brun-Lambert (*Electrochoc*) as well as Leigh Landy (*Understanding the Art of Sound Organization*).

In the scholarly literature, the problems of DJing as a musical practice and of electronic sound design therein occupy a modest place. Most materials are of descriptive character: these are

reviews of particular performances and achievements of specific DJs; publications about the restrictions imposed by the authorities in different countries and the difficulties the DJs faced due to the racial bias; stories about the development of different music styles in various clubs, etc.

The problems of electronic sound design and its applications in DJing have not yet been discussed in depth.

THE PURPOSE OF THE STUDY

The purpose of the study is to explore the relationship and dependencies between electronic sound design (with its means of creating rich soundscapes using electronic musical instrumentarium and computer technology) and the nature of DJing as a practical, creative and musical reality.

SPECIFIC TASKS TO ACHIEVE THIS PURPOSE

Task One: to apply methodologies such as a study of the principles of cognition and the organization of human activity to uncover key features of the nature of DJing, electronic sound design, and the ways in which they interact;

Task Two: to explore the achievements of the technical and technological revolution as a condition and factor for the development of electronic sound design and DJing;

Task Three: to reflect on temporal development in electronic sound design and DJing;

Task Four: to conduct a scientific and practical study of the evolution of electronic musical instruments and their implementation in the DJ instrumentarium;

Task Five: to explore contemporary techniques and technologies used in DJing.

OBJECT AND SUBJECT OF STUDY

The OBJECT of the present research is electronic sound design and its implementation through digital devices and electronic musical instrumentarium that create, reproduce, control, and model sound in DJing.

THE SUBJECT OF THE STUDY is DJing as a musical practice with its essential characteristics and manifestations.

BASIS OF THE STUDY

- Reviewing scientific sources such as dissertations, books, articles, and internet-based sources;
- Over 15 years of personal experience as a DJ and a composer;
- Working as a sound engineer at Bulgarian National Radio – Regional radio station Plovdiv;
- The communication with young people and specialists as well as personal experience gained through organizing and hosting many different musical and social events, some of them with international participation and significance;
- Education and training in the Music Department of the New Bulgarian University, from the

Bachelor's Degree to Master's Degree to doctoral studies.

THE RESEARCH HYPOTHESIS suggests the existence of the relationship and interaction between electronic sound design and DJing in the process of the scientific and technical revolution and their influence on the evolution of the DJ's creative musical activities.

METHODOLOGICAL FOUNDATIONS OF THE STUDY

The methodological foundations of the present work represent methodology as the doctrine of the principles of knowledge and the doctrine of the organization of human activity in two aspects: logical and practical rationality. They are used to conceptualize the nature of electronic sound design and DJing, and their interaction, and guide the scientific and practical research in this dissertation.

RESEARCH METHODS

In terms of logical rationality, the theoretical and practical methods of scientific research are applied in this dissertation, grouped as methods-operations and methods-actions (developed by Alexander M. Novikov and Dmitry A. Novikov [Novikov A.M., Novikov D.A. 2010, p.83 / НОВИКОВ А.М., НОВИКОВ Д.А. 2010, с.83]).

They are used to analyze and explain DJing and sound design.

Methods in practical rationality are methods for organizing human activity. They are employed to explore musical activity and technologies for creating electronic sound design and DJing as projects. The leading methods are methods for studying and summarizing experience, results of the activity, observation, and measurement.

The unity of the two aspects in the process of the research necessarily expresses the objective logic of the movement of cognition.

APPROBATION OF RESULTS

Results included in this dissertation have been reported at:

- Fifth Annual Doctoral Conference of the NBU, 19-23 June 2021, Sofia;
 - Scientific conference for PhD students and postdoctoral students with international participation "Young Scientific Forum for Music and Dance", 16-17 October 2021, NBU, Sofia;
 - International Conference "The Universe of Computer Music", 22 December 2021, Sofia;
 - FEMA Acoustics Conference, 2021, Sofia;
 - FEMA Acoustics Conference, 2022, Sofia.
1. Paper "Electronic Sound Design as an Object of Creative Activity", presented at the Fifth Annual Doctoral Conference of NBU, 19-23 June 2021, Sofia.
 2. Paper "Temporal and Actual Factors in the Evolution of DJing", presented at the Young Scientific Forum for Music and Dance: Conference with International Participation, 16-17 October 2021, NBU, Sofia.
 3. Paper "DJing – the Integrity of Technology and Music", presented at the International Conference "The Universe of Computer Music", 22 December 2021, Sofia.

4. Paper "Technical innovations in the hardware of standalone DJ player and controller Denon MCX 8000", presented at International Scientific Conference "Music Acoustics 2019", Sofia.

LIST OF PUBLICATIONS RELATED TO THE THESIS

1. Article "Technical innovations in the hardware of the standalone DJ player and controller Denon MCX8000"; journal FEMacoustics 7. / „Технически нововъведения в хардуера на standalone DJ плeър и контролер Denon MCX8000“; списание ФЕМАкустика 7;

2. Article "Electronic sound design as an object of creative activity"; journal Language and Publicity 2021. / „Електронният звуков дизайн като обект на творческа дейност“; списание „Език и публичност“ 2021;

3. Article "Electronic sound design in DJing as a creative activity"; journal FEMacoustics 2021. / „Електронният звуков дизайн в диджеинга като творческа дейност“; списание ФЕМАкустика 2021.

4. Article "DJing – the integrity of technology and music"; journal FEMacoustics, 2022. / „Диджеингът - интегритет на технология и музика“, списание ФЕМАкустика, 2022.

SUMMARY CONTENT OF THE DISSERTATION

The dissertation consists of an introduction, five chapters, a conclusion, an account of the contributions of this work, a bibliography, two appendices, a list and location of figures, and a list and location of tables. The text comprises 333 pages, of which 325 pages constitute the body of the text.

The cited literature includes 227 titles, of which 42 titles are in the Cyrillic alphabet, namely in Bulgarian and Russian; 6 titles are in the Latin alphabet, namely in English, 3 titles are electronic documents, and 180 titles are Internet-based sources.

The list of figures includes 158 items, and the list of tables is comprised of 13 items. Their location in the dissertation is also given.

The appendices in the thesis contain:

Appendix I, "Steps in the Development of Electronic Musical Instrumentarium with Analog Synthesis," presents 18 manufacturers of electronic musical instrumentarium with analog synthesis, along with textual and graphical information on 70 specimens of their production.

Appendix II, "Steps in the Development of Electronic Musical Instrumentarium with Digital Synthesis", presents 17 manufacturers of electronic musical instruments with digital synthesis, along with textual and graphical information on 45 specimens of their production.

MAIN PROVISIONS OF THE DISSERTATION

CHAPTER ONE: METHODOLOGICAL FOUNDATIONS OF SCIENTIFIC AND PRACTICAL RESEARCH INTO THE ELECTRONIC SOUND DESIGN AND ITS APPLICATIONS IN DJING

1.1. Methodological system - The dissertation applies the established in contemporary science principles of determinism, correspondence, and complementarity as the main guiding principles in the process of scientific cognition. Their application in the process of scientific cognition is a condition for the realization of the purpose and objectives of scientific research and for obtaining new scientific knowledge.

For the purposes of this dissertation, the methodological system is specified to explore electronic sound design and DJing and their boundaries as a sound form, technology and activity. It is tailored to the specificity of the research problem and has a multifaceted character. The methodological system integrates theoretical and practical principles and methods and manifests itself in two aspects - as logical and practical (instrumental) rationality. Both aspects are aimed at:

1. Theoretical study of the conceptual framework and terminology, and building/creating a scientific picture of the research problem; conducting a scientific and practical empirical study of the conditions and development of DJing, of the technologies and technical devices for the creation and use of electronic sound design as a means of discovering the links and interactions between them, as well as of summarizing the results concerning the revealed relationships and dependencies;
2. Research to uncover the stages and the extent of changes as well as to trace the relationship between the changes that have been brought about by the technical and technological revolution in the development of digital devices creating electronic sound design and applied in DJing.

The first aspect, logical rationality, relates to the principles of cognition. It helps construct the scientific picture of DJing and electronic sound design, their nature and limits of their manifestation, and complies with the structure of the cognitive cycle;

The second aspect is based on the principles of the organization of human activity. It is the practical (instrumental) rationality that allows to reveal the essence of DJing and electronic sound design as a creative activity and to undertake the scientific and practical study of the technologies, technical equipment and instruments involved in their creation.

1.2. Research methods and means - In logical rationality, logical means lead the way in the process of constructing reasoning, arguments, and drawing objectively true conclusions. They satisfy the requirements for describing the empirically observable characteristics of electronic sound design and DJing. They are also used to analyze the background knowledge about DJing and sound design. The rules for defining concepts and formulating definitions receive a special place and application. The definitions related to the language as a means of cognition reveal the content of concepts such as technical equipment, technology, project, electronic musical instrumentarium, DJ, DJing, electronic sound design. Definitions and classifications, definitions based on inferred characteristics, methods of studying the object diachronically, etc. are applied in the study of

specific problems in the individual chapters of the dissertation.

Methods within practical rationality reveal the organization of human activity in musical arts.

To organize the activity means to arrange it into a complete system with clearly defined characteristics, logical structures and the process of implementation [Novikov A.M., Novikov D.A. 2010, p.7 / Новиков А.М.,Новиков Д.А. 2010 с.7]. These components of the activity are the structural elements that are used to derive the characteristics of electronic sound design and DJing as a creative activity:

- As an activity: Process - Result - Organizational system;
- As a logical structure: Actor - Object - Subject - Form - Means - Methods - Activity Result;
- Temporal structure - Phases, Stages, Steps of activity.

Subsequently, these characteristics pertaining to specific activities are used to trace their development and look for dependencies between them.

The unification of theoretical and practical principles and methods in logical and practical rationality is a guarantee of creating a scientific picture of the problem under consideration.

CHAPTER TWO: REFLECTIONS ON THE TEMPORAL DEVELOPMENT OF ELECTRONIC SOUND DESIGN AND DJING

Every scientific project starts by specifying the concepts that are used in the research process, in the present case these are electronic sound design and DJing.

In the theory of music, the notion of electronic sound design is associated with technical progress and with the practical implementation of digital technologies, electronic musical instruments and the aspiration to realize new creative ideas with their help. Introductory concepts for electronic sound design are sound and design. The concept of sound design is determinative/class-descriptive for electronic sound design.

In English-language literature and speech, in a musical context, the term 'sound' is used in the broadest sense to refer to any sound phenomena of purely physical origin. In a narrower sense, the term 'sound' has been associated with specific musical phenomena since the second half of the 20th century and is interpreted as musical sound.

According to Lyubomir Kavaldzhiev, 'sound' or 'musical sound' is a term used by musicians and support professionals to name a range of features characteristic of a contemporary musical product. This includes, first of all, the features of its timbre, its spatial static localization, its spatial dynamics and the power (volume) of sound. If we are talking about a musical piece (live or recorded) or free music-making (improvisation), it is irrelevant whether it sounds like contemporary or traditional music, because an important nuance in this use of the word 'sound' is that the corresponding sonority is necessarily achieved artificially, i.e. with the use of modern technical means and through the creative work of relevant specialists (sound engineers, sound technicians, specialists in electroacoustics or architectural acoustics) who, along with the musicians, create the unique sound of the artistic production" [Kavaldzhiev, L. Modern musical terminology. /

Кавалджиев, Л. Съвременна музикална терминология. http://sscor.eu/Term_2007.pdf . According to Rositsa Becheva, the management of individual elements (layers of texture) allows for the implementation of changes in terms of timbre throughout the whole length [Becheva, R., 2018, p.355 / Бечева, Р., 2018, с.355].

The term ‘design’ means a project, plan, sketch, drawing; model, construction, composition. The Contemporary Glossary defines ‘design’ as artistic project development, shaping and arrangement of various products in order to enhance their aesthetic value. [Contemporary Glossary, 1994, p.160 / Съвременен тълковен речник,1994, с.160]. For the purposes of this study, both aspects of the concept are important.

There are various definitions of sound design: sound design is a term that denotes a type of creative activity in which sound is the object [<https://www.prosound.ixbt.com/education/sound-design.shtml>]. Sound design is a creative process for producing sound effects that are an integral part of contemporary music, motion pictures, video games, commercials, and theatrical productions [<https://www.rsi.ru/events/afisha/lections/saund-disajn-i-zvukovyye-sokrovishha-rgb>]; a creative process for editing and manipulating sound material to achieve a particular effect and meaning [Becheva, R., 2018, p.355 / Бечева,Р.,2018,с.10.].

Electronic sound design, realized by computer music systems, is an essential feature of the creative musical activity of DJing. DJing is the activity of making music and creating sound forms for a specific audience using technical equipment.

Chapter two explores the conditions for the emergence and development of electronic sound design and its applications in DJing, reflecting on electronic sound design, and on DJing as a musical practice in the following way:

2.1. Exploring the technical and technological revolution as a condition for the development of electronic sound design and DJing

2.1.1. Technical equipment and technology

The technique is the way in which humans process natural objects and events and transforms them into their living environment [Gerdzhikov, S., 1995, p. 104 / Герджиков,С.,1995,с.104].

Technology is a set of the most effective practices, methods and procedures for using the equipment and other technical means for processing raw staff, materials and articles and obtaining semi-finished and finished products.

The term ‘technology’ comes from Greek: *techne* - art, craftsmanship, craft and *logos* - word, teaching, science. It is the human mode of action organically woven into the labor of working with natural objects; of creating texts, tools, and machines; of rationally arranging elements and processes in science and art [ibid]. The technology involves the sequence of operations and procedures and is closely related to the technical means used, namely machines, equipment, tools and materials. Information technology is now powerfully emerging as a new type of organization of

human labour. The American scientist and philosopher Alvin Toffler, one of the authors of the concept of “super-industrial society,” interprets the last decades and the future of the West as a new stage, as “post-industrial society” or “the third wave of history” (*The third wave, 1980*) that comes after the traditional industrial society [Toffler A. *The Third Wave*. S., Peyo Yavorov Publishing House, 1991 / Тофлър А. Третата вълна. С., Изд.“Пейо Яворов“, 1991].

Technology is a science and a system that is based on physical, chemical, biological, social and mathematical knowledge. On the basis of information about how things are and through our goals, we humans come to the machine as an intermediary between the laws of nature and these goals of ours [Gerdzhikov, S., 1995, p. 105 / Герджиков, С., 1995, с.105]. The machine is a creation of the human, it is like a text in which the meaning is embedded which is its purpose. It is the materialized idea, the expressed concept, the embodied mind of the human creator [ibid]. In the present work, the content of the concept of technical equipment includes modern musical equipment – the different types of electronic musical instruments used for creative and performing musical activities. Technology is viewed as a set of methods and tools for achieving a desired result; a way of transforming the given into the necessary. Technology is the scientific and practice-oriented process of designing and producing instrumentarium, for creating electronic and computer music and for the performance and development of it. Music technology is also the way of practical application of instrumentarium. Modern technologies are based on the achievements of scientific and technical progress and are aimed at producing a certain product: material technology creates a material product, and information technology (IT) creates an information product. Electronic and computer musical instruments combine and apply both types of technology.

The dissertation traces the three stages of the technical and technological revolution, a transition from analog to digital technology, information and multimedia revolution, with their *specifics and characteristics*.

2.1.2. Electronic Devices - Electronic devices are an essential component in contemporary technical equipment. Electronics is known to be a branch of science and technology that deals with electrical circuits involving active electrical components and semiconductor devices such as vacuum tubes, transistors, diodes and integrated circuits. The non-linear behaviour of these components and their ability to control electron streams make amplification of weak signals possible and is commonly applied (emphasis in electronics) to information and signal processing. The processing of digital signals and the creation of digital circuits are increasingly well developed nowadays and find themselves in the focus of attention of electronics engineers.

Today, most electronic devices use semiconductor components to perform electron control. The study of semiconductor devices and related technologies is considered to be a branch of solid state physics, whereas designing and building electronic circuits to solve practical problems fall under the category of electronics engineering. [Electronics.Electronic equipment and technologies / Електроника.Електронна техника и технологии]:[Electronic document]. -

<http://protechnique.net/> - Checked on 04.02.2012. Electronic vacuum tubes, transistors, integrated circuits, sinusoidal voltage generators, relaxation generators, multivibrators, etc. have been applied in the electronic devices implemented and used to improve the musical instrumentarium. They have also become an essential design element in the architecture of the generations of computers that have emerged.

It is generally accepted to divide computers into generations depending on their design and technological basis and the appearance of fundamental additions in them. [Electronics.Electronic equipment and technologies Электроника.Электронна техника и технологии]: [Electronic document]. - <http://protechnique.net/> - Checked on 04.02.2012.

As of 2022, there are five known generations of computers, with the fifth having found massive use in professional and consumer electronics. Developments in the field of electronic devices and computer technology are the foundation for harnessing electronic sound and creating music at a new level.

2.1.3. Creating an electronic musical instrumentarium - The electronic instrumentarium includes existing electronic musical instruments (EMIs) and synthesizers that generate sound electronically using specific techniques and technologies. Like any generic concept, the electronic instrumentarium has essential and distinguishing characteristics by which it is differentiated and compared with others. The essential characteristic of the class of electronic musical instrumentarium is the generation of sound electronically. The distinguishing attributes are the specific techniques and technologies that are applied to the components of the sound. On this basis, we can create a classification of the representatives of the electronic musical instrumentarium, within which we will study two generations – the first and the second.

The method of controlling the sound with voltage is the characteristic of that part of the representatives of the electronic musical instrumentarium which form the first generation. Analog electronic musical instruments and synthesizers belong to this group. The transition from analog to digital technology is connected with the method of digital synthesis, in which the sound signal is represented by the generation of discretets (0 and 1). All electronic musical instruments that are distinguished by the production of sound by discretizing the signal are digital or second generation electronic musical instruments. The second generation is currently in its heyday.

Since focusing on electronic musical instrumentarium is an essential component in the process of achieving the objectives of this thesis, specimens of electronic musical instrumentarium of both types were analyzed in the course of the research (Appendix I of this dissertation presents the specimens of electronic musical instrumentarium with analog synthesis, analyzed for the purposes of the research. In Appendix II, the results concerning specimens of electronic musical instrumentarium with digital synthesis are presented. The content of both appendices is the basis of the scientific and practical research into the evolution of EMIs and technical devices in electronic sound design and DJing).

For electronic sound as a collection of harmonic components, synthesis is the method by which its harmonic composition can be altered. Obtaining new sound nuances depends on the method. The most popular sound synthesis methods are subtractive, additive, granular, wavetable synthesis, frequency modulation, and physical modeling. All types of sound synthesis are possible to be used with both analog and digital synthesizers, but due to their more pronounced mathematical specificity, some of them are very difficult to achieve with analog means. The most frequently used methods for analog equipment are the first two of the listed above.

Digital synthesis is built on a qualitatively new principle of sound production. Whereas in analog synthesis the voltage is a means to represent the value of the instantaneous sound pressure, in digital synthesis the instantaneous sound pressure value is expressed digitally with great precision. Digital synthesis is the representation of sound by discrete values. It is a technology qualitatively different from those applied in EMIs and first generation synthesizers. Digital synthesis is based on the theory of discretization. Its key principle is that the signal must be sampled at a frequency at least twice as high as the highest frequency in the signal spectrum in order for it to be represented by the discretized values accurately and without distortion. In practice, however, the sampling frequency is 2.5 to 3 times higher than the highest frequency.

Sound synthesis by digital means comes down to the generation of discretized values (0 and 1) that represent the sound signal. Depending on the required frequency range of the output signal, 20 000 to 50 000 discretized values per second must be generated. During each subsequent interval of duration of 20 to 50 μ s, a new discrete value must be generated. Signals that are interesting and useful in musical terms are programmed according to the predefined algorithms [*Lazarov, S., 1986, p.51 / Лазаров, С., 1986, с.51*].

The recorded encoded sound can be stored in memory and used for digital synthesizing. The advantages of digital synthesis are the high accuracy and flexible control.

The frequency, amplitude, attack and release time, and other parameters of the synthesized signal can be reproduced accurately for each of the programmed sounds. In practice, the most commonly applied synthesis methods with digital representation of sound are frequency modulation, wavetable synthesis, granular synthesis, and physical modeling.

The thesis analyses first-generation electronic musical instruments, namely electronic musical instruments (EMI) and synthesizers; and second-generation electronic musical instruments, including digital synthesizers, samplers, sound processors, drum machines, vocoders and others.

2.1.4. Summary - The technical and technological revolution has been a significant factor in the emergence and development of electronic musical instrumentarium. A relationship is revealed: the modification and development of technical equipment leads to the improvement of technology.

2.2. Reflections on Electronic Sound Design

2.2.1. Unfolding the Sound - The reflections on electronic sound design are traced in the process of unfolding sound as the basis and content of various musical phenomena. The characteristics of

sound as a physical acoustic and electroacoustic process are outlined. The following chain:

Sound (natural acoustic sound) → Sound Design → Traditional Music >>>

Electronic Sound → Electronic Sound Design → Electronic Music → Computer Music >>>

reflects schematically the steps through which the manifestation of sound passes from natural sound design to electronic sound and contemporary electronic sound design, in which the main building blocks are the components of sound.

The use and processing of the components of sound (pitch, intensity, duration, and timbre) in the creation of soundscapes (rather than entirely finished sounds) represents a technological revolution in music, and electronic sound design is a natural outcome of this, with manifestations in electronic and computer music.

The object of analysis is electronic sound and the components of sound involved in the creation of electronic sound design. In order to produce an electronic sound similar to the sound of an instrument, a large number of generators are required to create each tone. It is necessary to create a sine wave electronically with analog circuits that drive the generator either directly or by a change in voltage, but along with this a set of harmonic components must also be created using one generator for each of them.

Timbre is a defining component for building an electronic sound. Every soundscape in electronic music is defined by the set of sound timbres. In electronic sound extraction, achieving the desired timbre is a great challenge.

In principle, a certain timbre is obtained at certain ratios of the amplitudes of the individual harmonics in different sections of the instrument's sound range. Weakened or missing harmonics in the instrument's sound spectrum lead to a particular characteristic timbre. Missing even harmonics give a clarinet-like sound to the tone [Lazarov, S., 1984, p. 8 / Лазаров, С., 1984, с. 8]. Along with the sound spectrum, the timbre is also influenced by the character of the attack and release of the sound, the modulation of the sound during transients and stationary modes of operation.

Any harmonic sound vibration can be modulated by affecting and changing the frequency, amplitude and phase of the fundamental tone. Modulation is given the appropriate name: frequency modulation, amplitude modulation, phase modulation or a combination of them, and it is also possible to apply additional processing. From mixing the different types and dosing them in certain ratios, an infinite variety of sounds existing in nature and new ones born of the application of the performer's creative techniques can be obtained. Transients show how sound flows and changes over time. They add further depth and dimensionality to the sound and, together with the spectrum, create the specific timbre.

The true achievement of computer technology in the field of music is characterized by the complete mastery of processes that create, rather than use, sound. This allows the very notion of 'sound as matter' to be brought within reach of the (scientific and artistic) possibilities of the musician as a creator. The processes of creation, and respectively development, of the matter called

sound, by modeling each of its constituent aspects are in the musician's hands. And if we add to this the full control over the performance itself, which is indeed beyond technical capabilities of humans, it becomes clear that computer musical instruments offer neither more nor less than a direct connection with the musical imagination of the artist, the tone master [Detev, J. 1992, pp. 148 / Детев, Й. 1992, с. 148].

2.2.2. Electronic Sound Design - As it became clear at the beginning of Chapter 2, in music theory the notion of electronic sound design is associated with technical progress, with the introduction and application of digital technologies, electronic musical instruments and the aspiration to realize new artistic ideas with their help. The concept of sound design is defining, generic for the electronic sound design.

Sound design is the process of defining, acquiring, managing or creating sound elements. Very often it involves manipulations with previously recorded audio material, noises, music or sound effects. It may involve combining, altering in tonality, timbre and other modifications to create the required effect or mood. [Rymzhanov D., Moscow, 2013 / РЫМЖАНОВ Д., Москва, 2013].

Sound design has applications in film, television, radio, multimedia and advertising, theatre arts and contemporary genres of music.

In sound design, more and more attention is being paid to the interaction of sound and noise. The Russian researcher Maxim Bysko [*Bysko Maxim V.*] analyzed the need for a special field of science studying noise (or 'sound effects' according to English media terminology) as a creative artistic category in the field of artistic creation, alongside music and speech. Maxim Bysko defines the period from the first quarter of the 20th century to the present as a new sound age [Bysko M.V. *Noiseology*.//ENJ "Mediamusic", №3 (2014) / БЫСЬКО М.В. Шумология.//ЭНЖ „Медиамузыка“, №3 (2014) http://mediamusic-journal.com/Issues/3_6.html].

- *Electronic Sound Design*

According to the British researcher Tony Gibbs, "sound art is one of the most far-reaching of the modern arts and takes an extremely diverse range of forms (it can be found not only in music but also in fine art, film, interactive artworks, etc.), and sound design is the practical method of realizing its goals through melodies, harmonies, sonority structures, musical and non-musical instruments and technologies" [Gibbs, Tony. *The Fundamentals of Sonic Art & Sound Design*. Lausanne: AVA Books, 2007, pp.8-9.].

There are multiple research works that focus on electronic sound design – its essence and manifestations – that vary in terms of their nature and content. It becomes the subject of analyses with the development of digital equipment and technology. At its core are the manifestations of electronic music and the devices for its creation – starting with the pioneering activities of the world's first three studios (Paris , 1948; New York, 1951; Cologne, 1951) and the experiments and technical ingenuity of the engineers, acousticians and composers working in them and their

followers.

Electronic music emerged as a specific method of using sound engineering devices to produce and process the sound material intended for the composition process, the recording of which will be reproduced on magnetic tape [Lazarov, S., 1986, p.16 / Лазаров, С., 1986, с.16]. Its history includes the introduction of various engineering and technological means of creating sound sources – sine and noise generators, various echo-effect devices, modulators, with sound being recorded on single-track, two-track and four-track tape recorders and finally reaches a highly productive stage with the emergence of electronic sound synthesis and the creation of the electronic sound synthesizer.

The development of electronic sound design is enriched by the advent of digital sound recording. First of all, it is much cheaper and more accessible than its analog counterpart, but it also provides additional possibilities for processing the already recorded sound. Digitising sound waves transforms and compresses their structure to varying degrees in accordance with the input material, turning them into a series of ones and zeros, but allowing them to be reproduced on many different media [Pohlmann, Ken C., 2011, pp.47-75].

A new stage in the evolution of the electronic music environment is characterized by the development of computer musical equipment. It combines hardware and software, as basic principles of computer technology, with specific processes for the generation and processing of sound and sound components. The advent of the computer music system has unleashed new possibilities for high performance in musical arts.

The computer music system encompasses all spheres of musicianship, from the creation (synthesis) of complex musical sound and all forms of its treatment to the recording, printing and reproduction of musical pieces. Each of the devices in a computer music system is distinguished from its analog predecessors through an embedded microprocessor system used to control it, and through software stored in its memory [Detev, Y., 1992, p.3 / Детеv, Й., 1992, с.3].

The high quality artistic product that is created with these devices is implemented in the content and specifics of electronic sound design. The activity of its creation causes the sound picture of this artistic product to ‘come to life’.

The sound picture does not have the formal definitiveness of a painting or photographic art product. It has no permanent artistic framework, it is not bound to a definitive material formula. It is an abstract aesthetic substance that has renounced the absolute categorical nature of the means of expression, has loaded the spaces between symbols with meaning and value, and has turned the syntax of artistic language into an important gnoseological building block [Keremidchiev, I., 2019, p.9 / Керемидчиев, И., 2019, с.9].

Electronic sound design as a project, construction, composition of sounds and noises is created and realized to the greatest extent by computer music systems. Its path unites the chain

stretching "from each musical element to each musical image manifested in a particular creative process" [Detev, Y.,1992, p.15 / Детев,Й.,1992,с.15]. Its application goes beyond the confines of music stages and performance spaces, shows and concerts. Its manifestation in multimedia, theatrical, cinema and video productions is invariably fascinating.

The design is an electro-acoustic sound process. The electronic instrumentarium is brought to life through embedded problem-oriented programming. This is the other major part of the technology enabling flexible operation of microprocessor control systems ... on specific peripherals. Digital music devices of various purposes interpret each its own part of the analysis, processing or synthesis of sound, i.e. of the overall cycle treating the sound process and forms of creative work with it – from various types of tone generating devices, computer musical instruments (CMIs), to all computerized versions of sound processing, recording and reproducing devices [Detev, Y.,1992, p.15 Детев,Й.,1992,с.15].

Creating the desired electronic sound design in the space of a music event as a composition of unique sounds and noises is a manifestation of the DJ's creativity. The DJ shapes the soundscape by saturating it emotionally. DJ's skills and creative techniques give birth to the exciting, artistically intense and impactful musical performances.

With the widespread introduction of computer technology, all limitations for the composer, the arranger and the performer have disappeared, everything now depends only on the imagination and the skills of the artists [Traychev, 2019,п.73 / Трайчев,2019,с.73].

The more advanced the sound design tools, the richer and more impactful the DJ's musical creation. Electronic sound design, created by electronic devices based on digital programs, processed and broadcast by technical equipment, is the essential result of the DJ's work.

In an aesthetic as well as music technology context, for the composers of the 1950s-1960s, as well as for subsequent generations of Bulgarian artists, new music and a new musical language are primarily related to a new way of thinking about music in terms of the concept of a new sonic space. This is a space of ideas and specific composing realizations, and an examination of these reveals original replications of approaches as well as music technology practices that are perceived as modern (relevant) [Valcinova-Chandova,E., 2004,п.5 / Вълчинова-Чендова,Е., 2004,с.5].

2.2.3 Electronic and computer music - Electronic music is created using electronic equipment, a synthesizer or a computer. The artistically grouped sounds produced by such equipment constitute the electronic composition. Electronic sound is just as natural and acceptable as any other sound, although, like traditionally created sound, it has many varieties, each with a different quality and its own appeal [Lazarov,S.,1986, p.7 / Лазаров,С.,1986, с.7].

Electronic music has its own specific characteristics and uses the whole sound spectrum, creating conditions to free the sound from tonal fundamentals, from harmony and from the generally accepted intervals between musical tones. This provides opportunities for much greater creativity in the musical process. The synthesizer musician is at the same time an instrumentalist,

composer, arranger and sound engineer, which implies that they need to possess the required musical and technical knowledge. In the most general terms, electronic music is the result of a specific method of using technical devices to create and process sound material that is intended for the composing and the recording of which will be played back on magnetic recording tape.

It is also a natural progression for the electronic musical instrument. The introduction of technical innovations in musical activity brings about the need for a new type of musical instruments, constructed according to the requirements of the scientific and technological revolution. Musical instruments become technical devices that produce and simulate sound. First they are mechanical, then electromechanical and finally electronic and digital. According to Lee Landy [*Landy L.*], "most people associate the concept of electronic music with music in which sounds are synthetically generated" [Landy, L., 2012. p.3]. Computer music is the result of the use of sound synthesis and music composition technologies. Along with it, the musician is also a programmer. In addition to creating new sounds, the musician has to put together a program and sub-programs with a detailed and complete description of the musical instruments they want to hear, as well as to choose the tones of the musical composition, specific requirements for the sound timbre, etc.

The term 'computer music' now includes not only music composed with the help of a computer, but all musical forms in which there is some application and involvement of computer technology [Lazarov, S., E.Lazarov, 1989, p. 23 / Лазаров, С., Е.Лазаров, 1989, с. 23].

The term 'computer music' has two different meanings these days. In academia, the term primarily indicates the use of formal algorithms in the process of musical composition, and the other meaning is found in the popular sphere, where it is understood as electronic music that employs computer technology [*Brün, H., CornellUniversity Press, 1970*].

The computer and digital software nowadays concentrate the whole process in one unique and flexible system. Computer music uses software designed for sound synthesis and its transformations [Becheva, R., 2018, p.349 / Бечева, Р., 2018, с.349]. Their application in DJing is related to creating unique electronic sound design and strong artistic performance. In computer music technology the computer can perform for the DJ the role of a musical instrument; an interpreter; a creator of new music according to set algorithms; an improviser using musical phrases of live performers according to set programs.

As a summary of the review of the reflections on electronic sound design, the following findings can be presented: from the creative processes involving the components of electronic sound, endless variations for the manifestation of electronic sound design are born. This brings with it the development of new technologies for sound extraction, sound processing and creation of effects. Electronic sound design is built and processed using electronic devices. The advent of computer music systems is expanding the possibilities of electronic sound design for strong artistic performance in the musical arts.

2.3. Reflections on DJing as a musical practice - Creating a scientific picture of DJing in this dissertation brings together the following issues: aspects of the temporal development of DJing and relevant technologies; types of DJing; the evolution of DJing from a reproductive to a creative musical activity with an integral character, DJ equipment with analog and digital synthesis - DJ equipment with sound reproduction technology of analog and digital type, computerised systems and DJ controllers are presented. Creative work is the process of producing qualitatively new material and spiritual values in various forms. At the heart of DJing, at its very core one can find the technical equipment and technologies that it calls forth, creating conditions and opportunities for new explorations in the field of musical arts. The present study attempts to reveal/unveil the essence of DJing from a technological point of view and to trace its development up to the level of a creative productive activity.

Historically, for more than a hundred years, the DJs have shown their abilities on music scenes. During this time their role and functions have changed and evolved. At first, they presented and played ready-made music; gradually they began to mix and match them to their taste, creating and adding their own musical ideas and works, and thus captivating the audience, challenging them to dance. Finally, today, the DJ is a musician and an artist on the big stage.

Professional journalists Bill Brewster and Frank Bruton have conducted a significant diachronic study of the problem of the historical development of DJing in their work *"Last night a DJ saved my life: The history of the Disc Jockey."* Updated edition, 2013. A picture of the emergence and establishment of DJing as a musical activity is assembled by piecing together the activities of individual DJs, as if they were elements of a constructive kit. Drawing on interviews with DJs, musicians, critics, and record company representatives, the authors present the story of the profession of the enigmatic and charismatic man behind the turntable, who is at once a record collector and a psychologist capable of guiding the partying audience.

In the beginning, there was radio DJing. In the history of radio DJing, the term disc jockey, DJ, deejay or jock is also considered to describe personalities who present music compilations on the radio. Radio DJs introduce songs and musical performances instead of pausing between announcements, commentaries, and commercials.

The term disc jockey is believed to have been first used by American commentator Walter Winchell to refer to radio host Martin Block as the first successful DJ who eventually became a star. The phrase was subsequently shortened to the current abbreviation DJ. From this abbreviation, the term DJing was derived to encompass the entirety of the DJ's activities. An overview of the level of development of radio DJing is contained in the characterisation of the radio DJ. A radio DJ is a presenter on the radio who introduces songs, makes comments, and offers reflections between records. Starting out as an amateur experimentalist, a radio DJ eventually turns into a witty promoter of recorded music and proves how much power is locked up in music and the DJ's voice. The most influential radio DJs include Martin Block, Jimmy Savile, Pete Murray, Alan Freeman,

Zoe Ball, Chris Evans and others. Public opinion and press assessment of radio DJs are positive – the disco jock sets the trends. The DJ is the king in the entertainment world.

A new step in the development of DJing is its territorial expansion and the conquest of entertainment clubs – club DJing. Its distinctive characteristic is that along with its spatial development, DJing is enriched through the appearance of new functions of the presenter. Here the DJ is not just a presenter who introduces other people's music. Now the DJ is doing playback and mixing of pre-made recordings, placing an emphasis on the creative side of the musical performance. The DJ influences the state of mind of the people in the room, creating a common mood and spiritual empathy that are evoked by this joint experience. With music and dancing they show their satisfaction with life, unburden themselves emotionally, and express their energy. From a technological point of view, the DJ's job becomes more complicated as the DJs need to make their own combinations of the recordings and records at their disposal, guided by the structure of the chosen songs; to determine whether the melodies harmonize within them; to be able to seamlessly link them to achieve the desired effect on the audience. The club DJ mixes the transitions between songs to create a continuous flow of music. The technology with which the DJ carries out these activities is also evolving – the emergence of new modifications of turntables, mixers, amplifiers, sophisticated technical devices very often results from the DJs' own work. In the late 1970s, the idea of creating remixes entered DJing as a much more significant and productive one than simply making a track more danceable.

With the spread of digital electronic technology, new and greater opportunities have been created for DJing. Electronically produced sound, as a new possibility for musical performances, has given impetus to the invention and production of many new musical devices and instruments, but it has also prompted scientific experimentation with the different properties of electronic sound. The new role of the DJ is no longer just to present dance music. DJs now appear as remixers and producers as well. The combination of the DJ's own composition and reorganization of recordings of others turn the DJ into a creative musical personality. The DJs enrich their activities by developing the concept of a musical collage, preparing tracks and remixes, combining fragments of various compositions, making smooth transitions, using a variety of effects and adding their own original music. Modern equipment allows the DJ to perform much more complex manipulations and combinations to design dance music in a contemporary form. Proofs of evidence of the progressive development of DJing and computer technology related to it are the spectacular DJ shows and performances, outdoors, in the major cities in America, Europe, and Asia on various occasions, and the joining of more and more young people in them. In today's conditions, DJ equipment appears as a tool that introduces new technologies and helps the development of DJing in spreading this activity and adapting it to the changing conditions and circumstances. In such situations, radio DJing comes to the fore. It is also successfully combined with streaming.

Under contemporary conditions, radio is one of the more flexible and easy-to-implement

means of communication. [...] The publicity and usefulness for a piece of music, as well as influencing the audience with a particular musical production, are part of the functional scope of the radio. Even today – in the age of digital communication – it is the biggest and ultimately real possibility, and definitely the cheapest one, when working with music and for it [Shushulova-Pavlova, Milena. 2015, p.108 / Шушулова-Павлова, Милена. 2015, с.108].

DJing fits confidently into a variety of multimedia forms and events for young people as well as brings elements of these forms into the creative work.

It is safe to say that DJing is an emotive, improvisational art form, and this creates space for true creativity. The talented DJ does not just splice records together, but also controls the relationship between the music and hundreds of people [*Bill Brewster, Frank Broughton, "Last night a DJ saved my life: The history of the Disc Jockey."* Updated edition, 2013 p. 25]. In this way, the social aspect of DJing is manifested and realized.

Tracing the history of the development of modern DJ equipment in the dissertation is a necessary means of exploring the specifics of DJ technology. As technology evolves, new possibilities of sound modulation, sampling, and the creation of new sounds, rhythms, and timbres become apparent, sending DJing to a new level in music circles. Computer systems bring all of these together into one music DJing machine with vast possibilities which reflect the artist's/DJ's vision.

The new generation of musical instruments, computer musical instruments, are sophisticated systems for simulating complex musical sound, they achieve this with a sequential overlay of: signal-source (sound) synthesis, the inclusion of controllers managing different types of signal-source modulations, through which performing and acoustic effects are added. The first 'add-on' has two dimensions – providing all the expressive forms of musical sound known from performance practice with the acoustic instrumentarium and providing new performance possibilities creating a new expressive musical environment. Conventionally, expressive 'add-ons' can be divided into those that modulate pitch or dynamics of sound; and those that modulate various delays that, mixed with the original sound, produce additional acoustic effects. The most prominent representatives of each of the three categories are: vibrato, portamento, chorus effect, sound release, so-called 'free' reverb (right pedal on the piano), etc. [Detev, 1992, p. 38 / Детеv, 1992, с.38].

The following conclusion should be drawn: the diachronic development of DJing directly depends and is a consequence of the evolution and improvement of technologies applied in it. The emergence and practical application of each newly created component of the DJ equipment gives a boost to the creative manifestations of the DJs and raises the quality of the musical project to a higher level. Over the years, DJing technology has been enriched and refined.

A "completely new genre of musical expression" has been produced [History of DJ Equipment] [Online], Verified on 01.11.2021, Available at: <https://www.channelaudiogroup.com/single-post/history-of-dj-equipment>

2.3.4. DJing as a musical practice

The contributions of DJing to musical practice are as follows: DJing adapts music and makes it danceable; it broadens the foundations and (along with artistic value) generates a significant consumer value of music; it makes dance music a vehicle for prompting stylistic changes in it; it stimulates the recording industry; it provokes the emergence of new recording technologies; it has contributed to the emergence of radically new musical forms in recent decades; it has helped the emergence and validation of rhythm-and-blues, rock-and-roll, reggae, hip-hop and house, as well as many other genre varieties; along with its validation as a sonic form, DJing has skillfully co-operated with other art forms in the multimedia space and along with them participated in bringing about a true musical revolution.

In DJing, the construction of the desired electronic sound design in the event space as a composition of sounds and noises is a manifestation and an essential result of the creative activity of the DJ. Electronic sound design in DJing is an important component for modeling an appropriate emotional environment for communication and entertainment.

The true achievement of computer technology in the field of music is characterized by the complete mastery of processes that create, rather than use, sound. This allows the very notion of 'sound as matter' to be brought within reach of the (scientific and artistic) possibilities of the musician as a creator. The processes of creation, and respectively development, of the matter called sound, by modeling each of its constituent aspects are in their hands. And if we add to this the full control over the performance itself, which is indeed beyond human technical capabilities, it becomes clear that computer musical instruments offer neither more nor less than a direct connection with the musical imagination of the artist, the tone master [Детев, Ё. 1992, с.148].

2.3.5. DJ equipment – This part of the dissertation reviews DJ equipment based on the analog sound reproducing technology – turntables, reel-to-reel tape recorders, cassette recorders as well as DJ equipment with digital sound reproducing technology – CD players, DJ controllers and others.

2.3.6. DJing – summary

At present, DJing is an established musical practice with an active influence on shaping music culture in the society. As a sound form, DJing is a manifestation of art and culture with a social role to unite young people, this conclusion drawn from the study of DJing in this dissertation is a reaffirmation of the evidence offered by Prof. Dr. Milena Shushulova that brings in the new concepts of openness of relationships between music and audience aimed at "creating a suitable environment for musical understanding, for musical communication, for musical culture to happen"[Shushulova-Pavlova, 2015, p. 12 / Шушулова-Павлова, 2015, с. 12].

Through new technologies, the possibilities of creating rich and unique electronic sound design are manifested and realized. Building the desired electronic sound design in the event space

is an important component in creating a suitable emotional environment for communication and entertainment and an essential outcome of the creative work of the DJ. The applications of electronic sound design turn DJing into a musical practice of creative nature.

A specific characteristic of DJing is that it is one of the rare activities and professions that combine and integrate into a unity the achievements of the engineering science, the art of music and the DJ as an artist, composer and performer embracing direct communication with the audience.

In the process of tracing the diachronic development of DJing, both the nature of the professional growth of the DJ and the stages through which it passes are revealed.

2.4. Conclusions

1. The study of the equipment and technology implemented in electronic and computer musical instruments and systems reveals the relationship and dependencies between them. The application of technical innovations in musical instrumentarium leads to structural changes and improved technical performance. This influences the music making technology and the creation of sound design.
2. There is a direct positive relationship between equipment and technology in musical instrumentarium. This relationship is a factor in improving the quality of the musical product being created through the diverse options for the manifestation of electronic sound design resulting from the manipulation of electronic sound. Electronic and computer musical instruments and systems create and reproduce sound possessing the spectral characteristics of frequency, amplitude, phase and their modulation. The process of editing and manipulating sound material in electronic sound design is materialized in the richness of sound pictures, images and effects and in electronic and computer music applied in different types of DJing.
3. Electronic sound design is the creative process of processing and manipulating sound material for a specific purpose. It develops, enriches and builds upon sound design created with traditional equipment and technologies. While sound design as an expression of artistic creativity involving traditional sound creates sound environments in the form of sound images, pictures, and effects, electronic sound design, along with these forms, creates unusual sound elements and effects. Apart from its application on the radio and television, in the cinema, multimedia, advertising, and the theatre, it also has an essential role in the musical practice of DJing. Electronic sound design helps to express the aesthetic intent of the artist and to shape musical taste in the audience. The more advanced the means of creating electronic sound design, the richer and more impactful the musical creation.
4. With its essential characteristics and manifestations, DJing is a new musical practice, in which the various manifestations of electronic sound design find application. Electronic sound design and DJing as processes contain and unite two types of activities – engineering and music. The musical instrument in DJing is the medium of musical practice as activity (DJing) and the product that is

produced (electronic sound design) by virtue of the active role of the DJ.

5. DJing, with its essential characteristics and manifestations, is the new musical practice in which the various forms of electronic sound design find application.

CHAPTER THREE: SCIENTIFIC AND PRACTICAL RESEARCH INTO ELECTRONIC SOUND DESIGN AND DJING

Chapter Three explores the concepts of electronic sound design and DJing and their boundaries as forms of scientific knowledge and practical activity. A theoretical derivation of the essential and distinguishing characteristics of these concepts as a sound form and as a form of practical activity is made. Relating concepts to definite practical activities is a means of inferring the precise meaning of words and revealing the logical dependencies between them.

3.1. Forms of manifestations of electronic sound design and DJing in scientific knowledge

3.1.1. Electronic sound design as a form of organization of scientific knowledge, the concept of electronic sound design - At the theoretical level of the established forms of scientific knowledge organization, to define and explain electronic sound design, we can correlate the fact, concept and category. Electronic sound design exists as a result of the activities of musicians, composers, DJs, engineers and others in the media and multimedia space – at concerts, theatre performances, shows, in musical pieces, cinema, audio and other productions. As a form of thinking, electronic sound design is a concept. It emerges from the intensive scientific and technological development in music and the knowledge, skills, and possibilities of technical sound production and sound processing accumulated in practice. In musicology, the concept of electronic sound design is a form of reflecting the surrounding world through thinking, by means of which the essence of musical phenomena and processes is cognized and their essential aspects and attributes are summarized.

Electronic sound design manifests itself as a form (sound form) and as an activity that brings together processes and technologies of the construction of a sound form.

The content of the concepts is expressed in the set of distinguishing and essential properties of a group of objects [Lazarova Lydia, Anna Beshkova, 2002, p.16 / Лазарова Лидия, Анна Бешкова, 2002, с.16].

For the concept of electronic sound design as a sound form, the essential properties or characteristics are: the type of sound design; the manifestation of a specific type in the sound system; the sound project; the sound construction; the sound composition; the result of the creativity of the DJ, musician, composer; the unique audio product; the creative sound form; the musical form; creation of rich sound pictures, images, effects, compositions; the form of artistic creativity; the result of technical musical activity realized with electronic instrumentarium; the sound product of a specific computer technology with digital and electronic technical devices; the form that combines music, speech, and noise; being expressed in sound space; the result of unique sound modifications; the result of the application of technology in DJing; having different ways of

manifestation; combinability with other art forms; the component of sound culture; the component of sound art; the component of musical art; the component of audio-visual art; the component of multimedia products and computer games.

The distinguishing properties are as follows: digital base; digital sound processing; sonic manifestation through EMI and computer technology; all stages of sonic content can be realized by a single person; accessible technology; allows the use of minimal instrumentarium; product of the technological revolution; result of the technical revolution; expression of a musical phenomenon.

The interpretation of the logical relations of the concept under study with other concepts in this domain is visualized in Scheme 1 and Scheme 2.

Scheme 1: Electronic Sound Design - Sound Design - Sound Art - Sound Culture;

Scheme 2: Electronic Sound Design - Sound Design - Sound Art - Music Art - Multimedia Art - Art - Sound Culture - Culture.

The two schemes (1 and 2) bring together and organize the concepts essential for the field under study according to the degree of commonality.

3.1.2. DJing as a form of organization of scientific knowledge - the concept of DJing - The content of the concept of DJing reflects the most general characteristics of this activity, namely: sound form; productive activity; musical activity; creative activity; artistic activity; reproduces and creatively transforms musical works; activity that creates sound forms; activity of making music with technical means; product of specific computer technology; activity to create electronic sound design; form that combines music, speech, and noise.

The distinguishing properties of the concept of DJing include: specific technology of implementation; required DJ hardware and software/computer technology; availability of DJ equipment; digital and analog sound processing; all stages of the activity can be implemented by one person; affordable technology; it allows the minimal use of instruments; it has different modes of manifestation; the features manifest in unity; it is influenced by the technical development; it is influenced by the technological improvements; it stimulates the recording industry; it triggers the emergence of new recording technologies; it has contributed to the emergence of radically new musical forms in the last five decades; it turns the DJ into an artist.

3.2 Forms of manifestations of electronic sound design and DJing as a practical activity

3.2.1 Electronic sound design as a manifestation of practical activity

Characteristics of electronic sound design as a practical activity:

1. Particular qualities: it is a creative activity that obeys the principles of activity organization and integrates the process, result and organizational system.

Electronic sound design as a process is the implementation of computer technology by the DJ and the creation of a unique audio product from various components with harmonious

relationships between the parts of the whole. Electronic sound design as a result is an electronic music project/audio product with artistic value. Electronic sound design as an organizational system expresses the internal orderliness and coherence of its components in sound form. As a composition that is created in the sound space, it is the musical environment and the manifestation, the connecting link in the 'DJ – audience' relationship.

The concept of electronic sound design as an activity reflects the following: the process that includes the project, technology, reflections on the sound material; it is realized by a DJ, musician, engineer, composer; a productive musical activity; a specific computer technology; sound extraction with various technical devices and means; sound processing with electronic and computer means; computer technology with electronic musical instrumentarium that creates an artistic sound form; a means of expressing the creative abilities of the DJ; method of realizing sound art; method of creating musical works; unfolding the unique musical composition; programmable systems.

2. Logical structure of electronic sound design:

- Actor - the person working with the audio equipment, the artist, the DJ;
- Object - sound with changing parameters; sound and noise; sound, speech and noise;
- Subject - organization of sound material in time and space;
- Form - electronic sound extraction, electronic sound synthesis and its transformations, noise-speech-music;
- Tools - digital devices and algorithms that create, model and control sound;
- Methods - computer music making;
- Outcome of creative activity - audio compositions, musical harmony.

3. Temporal structure of electronic sound design - the temporal structure of each activity contains the following components: phases (project planning, technological phase, reflective phase), stages (conceptual stage, modeling and construction, technological preparation and implementation) and steps (problem formulation, idea; goal definition; criteria selection; technological preparation; implementation).

The process of implementing electronic sound design is the activity of the DJ with the necessary specialized equipment to create sound pictures, images and compositions with unique and unusual sounds. By using the capabilities of computerized music systems, a very rich and artistically sophisticated electronic sound design is created.

3.2.2 DJing as a form of practical activity

In practical terms, DJing reflects the organization of human activity as a musical process, result and organizational system.

DJing as a process reflects a set of actions and operations in a particular system to create and refine the interrelationships between the DJ, the musical equipment and the sound environment aimed at the realization of an artistic goal for a particular audience while providing the necessary

conditions and organization for performance.

DJing as a result reflects the realized internal order and coherence of system components of the musical project. It is a manifestation of the achieved harmony of the realized product with electronic sound design within it.

DJing as an organizational system is an association of people who jointly realize a specific program or goal – radio DJing, club DJing, event DJing – and act according to certain rules and procedures. To organize the activity means to arrange it into a complete system with clearly defined characteristics, logical structures and process of implementation.

1. Characteristics of DJing as a form of practical activity: musical activity; creative activity – it includes the project, technology, reflections on the sound material; specific technology for creating sound design; sound production with various technical devices and means; sound processing with electronic means; computer technology defines the place of DJing in musical environments; realization of musical projects; creation of unique sound design; method of realization of sound art; method of creating musical pieces; programmable systems.

2. The logical structure of DJing as a form of activity unites:

- Actor – the DJ and the audience;
- Object - electronic sound design;
- Subject - presentation of music art projects for a specific audience;
- Forms - sound, electronic sound;
- Means - analog and digital equipment, DJ techniques and computer technology; music set, remixed and original music; algorithmic composing;
- Outcome - musical pieces, creativity, musical activity.

3. The process of DJing as a form of activity is essentially the realization of a musical project in front of a specific audience. It combines preliminary preparation of the necessary material base, preparation of the conceptual project, technology of performance, musical equipment and musical set, compositions and realization. The technology of performance brings together in a sequence the processes by which action algorithms are constructed from the defined elements in precise compliance with the planned means, technique and musical equipment. In sound reproduction, the possibilities of sound modulation, sampling, creation of new sounds, rhythms and timbres are manifested as a leading ingredient in DJ technologies. Computer systems combine all these into one music DJing machine with enormous possibilities, according to the vision of the artist/DJ. With this, DJing secures a position/new level as a creative activity in music circles. For any particular realization of DJing in creative practice, certain sets of conditions are taken into account.

The term DJing is an umbrella term that encompasses both the sound form and the entire activity and technology of creating a sound design and manifesting it in front of an audience. In accordance with the level of evolution of science and technology, the concept of DJing is in a state

of development and change. The development is reflected in the increasingly adequate representation of reality and human artistic needs.

CHAPTER FOUR: EXPLORING THE EVOLUTION OF ELECTRONIC MUSICAL INSTRUMENTS AND TECHNICAL DEVICES IN ELECTRONIC SOUND DESIGN AND DJING

The study is carried out in three parts:

1. An empirical study of the development of electronic musical instrumentarium as a result of scientific and technological progress. The practical results are in the form of conclusions, tables and two appendices, Appendix I and II, entitled "Steps in the development of electronic musical instrumentarium", with analog and digital synthesis, respectively.

2. Temporal study of the relationship 'Technological Revolution - Electronic Musical Instrumentarium'. It reveals the relationship between the creation of electronic devices and their technological application in the electronic musical instrumentarium developed in this period. By its nature it is a diachronic study and correlation of the technical devices that emerged as a result of the technological revolution and the electronic musical instrumentarium characteristic of the period. The results are presented in comparative tables by period (*Table 4.3 - Table 4.7*) in relation to the generations of computers created and the electronic elements incorporated into their design and technology. A separate table (4.8) shows the dependencies in the field of DJing.

3. A study of the DJ instrumentarium through a comparative analysis of two of the most common DJ sets: the Pioneer CDJ-100 CD player complete with mixer and the latest generation Denon MCX 8000 DJ controller.

The empirical study illustrates the specificity of DJing as a practical activity.

CHAPTER FIVE: MODERN TECHNIQUES AND TECHNOLOGIES FOR DJING

In chapter five, the work with the DENON MCX 8000 DJ controller is reviewed and experience of working with the applied technologies for radio DJing in Bulgarian National Radio is shared in two interviews. In the interviews, the topic "Elements and technologies of radio DJing in Bulgaria" is presented as seen through the eyes of some of the first participants in radio DJing activities in Bulgaria. The interviewees are the chief engineer in BNR – Radio Plovdiv – Eng. Minko Krastev and the coryphée of radio DJing in Bulgaria Toma Sprostranov.

CONCLUSIONS

The summary and the conclusions, which are drawn on the basis of the scientific and practical dissertation research, can be structured according to the tasks realized in the thesis: the conclusions related to the DJing and the electronic sound design in the musical arts seen as elements of the structure of the conceptual form of science in the musical sphere; conclusions concerning the relationship 'technique – technology – musical instruments – DJing'.

DJing

DJing as a practical activity is a new path in music. With the application of the latest

advances in technical equipment and technology, it transfers and combines the old, classical hardware and software methods of making music and transforms them through digital technology and computer systems into part of the music technology of the 21st century. Electronic sound design unleashes the potential inherent in traditional sound and thus elevates music to a higher level without conflicting with traditional music. This helps to establish the place of DJing in the field of the musical art.

Since its very inception and airplay appearance, DJing has come a long and complex way of proving itself and establishing itself as a musical form. Today, in the computer age and the era of digital technologies, when one century has passed, we can view it as the latest proven player and representative in the music culture with its social role to unite and inspire young people.

DJing as a musical practice contributes to music culture. It expands the foundations and enhances the artistic and consumer value of music. It adapts music and makes it danceable as well as becomes a means of prompting stylistic changes in it. DJing stimulates the recording industry and provokes the emergence of new recording technologies.

It has contributed to the introduction of radically new musical forms in recent decades helping the emergence and establishment of rhythm and blues, rock and roll, reggae, hip hop and house, and many genre varieties. DJing helps develop the young people's musical taste and acquaints them with modern music culture.

Along with establishing itself as a sound form, DJing gets skillfully combined with other art forms in the multimedia space. Together, they are involved in bringing about a true musical revolution.

The temporal development of DJing is directly dependent on and a consequence of the development and improvement of the music technologies applied in it. The emergence and incorporation into practice of each newly created component of DJ equipment gives a boost to the artistic endeavors of DJs and raises the quality of the musical project to a higher level. Over the years, the technology of DJing has been enriched and refined. A "new genre of musical expression" has been created.

The nature of DJing can generally be said to reflect the activity of making music and creating sound forms using technical equipment for a specific audience. What is specific to music making is the combination of multiple techniques of recording, reproducing, mixing, remixing into a single process; creating and presenting one's own musical production and combining it with the music of other composers.

The transition of musical practice in DJing from a reproductive to a creative activity reflects the evolution of DJing as an activity. In DJing, the evolution of the role of the presenter (the DJ) is realized and traced. The journey from playing music with a turntable, to creating and presenting original music compositions with the help of a computer, elevates the DJ into an artist capable of saturating the space with unique electronic sound design. Through it, music expands its boundaries

and reaches new heights in composition and performance. In practice, the DJs, through the sonic art of DJing, establish themselves as a factor in the art of music. DJing proves to be a sound art possessing an artistic and aesthetic nature and exercising an active influence on the formation of the young people's musical culture.

Electronic Sound Design

The technological revolution has materialized new ways of thinking and a new musical language through a revolutionary music technology, instrumentarium, electronic and computer music. With its emergence, electronic sound opens up limitless possibilities for sound extraction, sound processing, and creation of effects.

The technology of sound extraction operates on the level of sound components, sound oscillations of different shapes are used; spectral characteristics, i.e. frequency, amplitude, phase and their modulation, are used to create and reproduce sound.

The characteristics of electronic sound components are investigated and evaluated based on and analogous to those of traditional sound. Developments in computing and technology are turning technical devices producing and modeling sound into musical instruments and integrated musical systems.

Sound design is a form of artistic endeavour that creates sound environments in the shape of sound images, pictures, effects and other manifestations.

Electronic sound design, as a type of sound design, is created using electronic devices as well as processed and emitted by technical equipment. It makes use of the entire sound spectrum and this finds manifestation in the richness of sound pictures and images. It may involve combining, altering in tonality, timbre, changing the loudness and dynamics of the sound, extending the limits of low and high registers, and other modifications to create particular effects. It is also used to create unusual sound elements.

Electronic sound design develops the sound design created with traditional sound, enriches it and builds on it. Its essence is the creative process of processing and manipulating sound material for a specific purpose, and it has applications in film, television, radio, multimedia, advertising, theatre, and all genres of music and performing arts.

In DJing, the construction of the desired electronic sound design in the event space as a composition of sounds and noises is a manifestation and result of the DJ's creativity. Created with the help of electronic devices based on digital programs, processed and emitted by technical equipment, the electronic sound design is the essential result of the DJ's work. With the advent of computer music systems, new possibilities for high artistic performance in the musical art, manifested through electronic sound design, are unfolding. The more advanced the means of creating electronic sound design, the richer and more impactful the DJ's musical creation. Sound design is a practical method of realizing sound art.

All the prospects lying before DJing and electronic sound design within it are incredibly

exciting.

Technical equipment - technology - musical instruments - DJing

From the research conducted in this dissertation and the analysis of the data in the tables with examples of electronic musical instrumentarium and DJ equipment, the following findings and conclusions can be drawn:

The development of electronic musical instrumentarium and the evolution of electronic technical devices are interrelated and interdependent. The stages of manifestation of the technological revolution in technical devices condition the development of musical instrumentarium.

There is commensurability in the design, technology and pace of development of technical devices and electronic musical instruments.

The beginning of the rapid development of musical electronic instrumentarium began with the introduction of semiconductors and the advent of second generation computers. This development continued to be extended and enriched with the improvement of integrated circuits and the introduction of computer languages for logic programming.

The improvement of computer systems and the development of numerous applications expand the 'computer-musical instrument' interaction. Embedding a computer in the synthesizer turns the musical instrument into a system with unlimited possibilities. Computer technologies are becoming technologies for operating the synthesizer as an orchestra with multiple instruments in it - real existing instruments and artificially created instruments. Representatives of the electronic musical instrumentarium are becoming more and more compact and convenient to operate.

The conclusions have confirmed that the modern computer with its programming capabilities and digital technologies for sound synthesis and processing turns electronic musical instruments into systems with immense possibilities for music making and composing.

The technology and DJ equipment unleash the possibilities of the DJ as an artist – a musician, composer, performer, and engineer.

With the development of each new electronic musical instrument, the latest scientific and technological advances are implemented. These results exercise their influence on the evolution of electronic sound design and DJing as a musical production.

The detailed review and study of the equipment and technology and the analysis of their application in electronic and computer music instruments and systems confirm the existence of the relationship between them. The development of technology leads to a change of musical instrumentarium in terms of design and technical characteristics. These changes influence technologies used to work with the instrument and music making as well as reveal the relationships and dependencies of electronic sound design and applied equipment and technology.

Newly developed technologies are challenging instrument manufacturers to overcome problems encountered to improve the quality of the musical product or refine performance

technology. There is a direct positive relationship, i.e. a change in terms of equipment leads to the change in technology. The direction of it is development and improvement. The equipment develops the technology and the technology improves the equipment. Musical production is the immediate consequence that possesses their characteristics, which manifests the existence of mutual dependence.

The musical instrument in DJing is the medium of musical practice as an activity (DJing) and the product that is produced (electronic sound design) through the active role of the DJ.

Computers evolve into universal music systems. The pervasiveness of changes in computer music-making technologies makes them revolutionary. Computer technology directly influences the compositional process and advances DJing as a musical creative activity.

Empirical research on electronic music instrumentarium and DJ equipment confirms findings from theoretical studies of DJing, electronic sound design, and the relationships between them.

In the present study, conducted according to the methodological and methodic propositions, we have found the following: the relationship between electronic sound design and DJing is mutually determined. It is developed and refined through the manifestations of electronic sound design in different DJing activities with the help of computer music systems and equipment. Electronic sound design and DJing as processes contain and unite two kinds of activities – engineering and music.

The concepts of DJing and electronic sound design

This dissertation includes: a theoretical study of the conceptual apparatus and terminology in DJing and electronic sound design; a scientific and practical study that traces and reveals the stages and the extent of changes in the relationship and dependencies that have been brought about by the technical and technological revolution in the development of digital devices that create electronic sound design and are applied in DJing.

The notions of DJing and electronic sound design as expressions of real musical activity and phenomena, and as a sonic form, are derived from the analysis of the instrumental and logical rationality of the technical and technological revolution, the development of electronic musical instrumentarium and DJing as a musical practice. They bring together characteristics of these fields. Relating the concepts to the defined practical activities helps to bring out the precise meaning of the terms and reveal the logical dependencies between them.

The scientific and practical study of DJing and electronic sound design from the point of view of logical and instrumental rationality presents a scientific picture of electronic sound design and DJing as forms of organization of scientific knowledge and as forms of practical activity. The two concepts of DJing and electronic sound design are borderline concepts in art and engineering sciences. They have common characteristics and interact.

The scientific and practical study of DJing and electronic sound design in essence is an

attempt to derive and confirm these concepts as elements of the structure of the conceptual form of science in the field of music.

The concept of DJing, like any other concept, is a product of the historically evolving knowledge about a particular musical activity, which over time, as it ascends from a lower to a higher stage, generalizes on the basis of practice the obtained results that concern a growing number of characteristics, as well as refines and clarifies the old boundaries of the concept and formulates new ones.

DJing is a collective term that encompasses both the sound form and the entire activity and technology of creating a sound design and sharing it with the audience. In accordance with the level of development of science and technology, the concept of DJing is in a state of development and change. The development is reflected in the increasingly adequate reflection of reality and human needs. As a result, the theoretical foundations of DJing as a musical activity are enriched.

The term ‘electronic sound design’ reflects the content of electronic sound design as a form (sound form) and as an activity involving electronic sound (processes and technologies of sound form construction). As a collective concept it unites the essential and distinguishing characteristics concerning its manifestations as a practical activity and a sound form.

The results obtained in the course of the research confirm the thesis – the applications of electronic sound design in DJing contribute to its formation and establishment as a creative musical activity.

From the research point of view, it is necessary to establish a research methodology for a new applied discipline in the field of DJing which can be useful for computer music-making as a learning, creative and performing art.

MAIN SCIENTIFIC CONTRIBUTIONS OF THIS DISSERTATION

1. Implementation of a specific methodological system for the study of electronic sound design and its applications in DJing with the means of logical and practical rationality.
2. Enriching the scientific picture of musical activity by revealing the nature of DJing and electronic sound design on a theoretical level as concepts with their essential and distinguishing characteristics and on a practical level as a creative technological and practical (performance) activity.

The nature of DJing is revealed in two aspects: on a theoretical level as a concept with its essential and distinguishing characteristics and on a practical level as a creative technological and practical activity. It is proven that computer technology directly influences the process of composing music and improves DJing. Thanks to the evolution of DJ equipment in its last generations, the application possibilities of DJ controllers have been increased and expanded – they can be used not only on the stage, in clubs and studios, but also for radio DJing. They find particular application in radio one-man shows. The manifestations of DJing are grouped and systematized as types of DJing, which is an original typology of DJing.

The evolution of electronic sound design in DJing is traced to an audio product of high artistic value and application. Electronic sound design in the process of sound unfolding and its manifestation in various forms and the factors for its improvement are explored. The characteristics of the concept of electronic sound design as a sound form and practical activity are outlined.

3. Tracing and revealing the evolution of DJing from a reproductive to a creative musical activity integrating art with engineering.

4. Revealing the nature of the relationship between electronic sound design, equipment and DJing and highlighting inherent patterns by analyzing and comparing specimens of electronic devices, electronic musical instrumentarium and DJ equipment. The interdependencies of technical and technological innovations in the field of musical art and their relationship with DJing and electronic sound design are investigated. The specificity of DJ technology is explored through the development and improvement of DJ equipment, and the relationships and interdependencies between them are revealed. Empirical research confirms and proves the findings of theoretical studies in the field of DJing and electronic sound design.

5. The social role and significance of DJing as a creative musical activity are demonstrated by revealing the artistic and aesthetic nature of the electronic sound design that constitutes it. In times of limited physical attendance at clubs and mass indoor and outdoor events, DJing, broadcast over radio or online, removes physical barriers and enables the audience to access musical art on a global scale.

6. The study of electronic sound design and its applications in DJing from a scientific, technical and technological point of view as a means of enriching the contemporary scientific picture of the level achieved by the '*equipment – music*' relationship in theory and musical practice, as well as of the formation of musical culture.

MAIN APPLIED SCIENTIFIC CONTRIBUTIONS OF THIS DISSERTATION

1. The developed systematic procedure for revealing the nature and tracing the development of DJing as a creative musical activity and sound art with an integral character enriches the scientific understanding of the applications of electronic sound design in DJing.

2. The results of the study can serve as a basis for further scientific and practical research focusing on the given problem and for the development of future methodologies, curricula, textbooks, etc., related to computer music education and in the field of DJing.

3. The conducted analysis of the approach used in the realization of DJing with relevant equipment and the shared practical experience can facilitate the work of the DJs and support them in their creative and practical activities.

ACKNOWLEDGEMENTS

I would like to express my sincere and most heartfelt gratitude and appreciation to my supervisor Prof. Dr. Simo Lazarov for his valuable guidance, supervision, professional competence and assistance in conducting the present research and preparing this dissertation. I am also extremely

grateful to him for his priceless moral support and patience.

I thank Prof. Dr. Milena Shushulova-Pavlova, the staff of the Music Department at NBU and Prof. Dr. Yavor Konov for their help, creative opportunities given to me, responsiveness and research approaches shared with me.

I thank Assoc. Prof. Dr. Rositsa Becheva, Chief Asst. Dr. Emil Traychev and all the lecturers in computer music and sound engineering for their support. I am grateful to the colleagues from the Center for Computer Music and Computer Sound Processing "Stanislav Stanchev-Stanley" at NBU Sofia for the assistance and support as well as for the creative discussions.

I thank Eng. Minko Krastev – the Chief Engineer in Bulgarian National Radio – Radio Plovdiv for the fruitful discussions about the technologies of radio DJing in Bulgaria and the interview. I express gratitude to Toma Sprostranov for his assistance and the interview.

My special thanks go to my family, friends and colleagues in Bulgarian National Radio for their support and stimulating guidance.

WORKS CITED