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Research Article

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# Modern possibilities of diagnostic research in the field of forensic video and audio analysis

*Issues that are increasingly arising in criminal proceedings are highlighted, namely: use of data obtained as a result of diagnostic researches on video, sound recordings that allows to ensure a higher level of completeness, objectivity and comprehensiveness of research. The purpose of the article is to analyze the possibilities of forensic diagnostic researches on video and sound recordings of both oral speech and the sound environment of an offense event. Various modern possibilities of researches on video and sound recordings are considered. Attention is paid both to the specifics of diagnostic speech researches in order to obtain information about personality of the unknown speaker and to information that can be obtained through research and diagnosis of non-speech information. Analyzed the possibilities (within the framework of the examination of video, sound recording) diagnostic researches on directly speech information, including the definition of: oral speech form, nature of relations between the interlocutors, conversation meaning (definition of the meaningful situation: consent vs disagreement; permission vs prohibition; understanding vs misunderstanding; request; advice; promise; assurance; gratitude; threat; clarification; order; question; message, etc.), rate of speech and the emotional state of the interlocutors, as well as expert diagnostics of biological parameters of the speakers. Possibilities of diagnostic studies of technical studies of recording media and recording equipment, that can contain information about the technology of obtaining/fixing/saving video, sound recordings, properties, and features of the media itself are considered. Non-speech sounds are classified according to their belonging to certain sources. The article highlights effectiveness of using the forensic information obtained through forensic examination in practice of investigating crimes.*

***Keywords:*** *forensic video and audio analysis; sound environment; diagnostic researches; non-speech signals; research; speech.*

**Formulation of Research Problem.** A special role in criminal proceedings (in particular, in criminal procedural proof) is drawn to factual data obtained from video and audio recordings. This is due to the fact that factual data contained on storage media, given the possibility of their perception and verification after a certain time, are characterized by a certain degree of


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reliability; they can often be used in proof without disclosing sources and methods of obtaining them.

Results of forensic video and audio recordings can be used while investigation only if they are duly processed in procedural-forensic way. The procedural aspect is governed by the criminal procedure law, and rules of technical format have been developed in practice.

Reproduction of video and audio recordings (both while preliminary investigation and trial) facilitates the perception of a corresponding information, creates a *being there* effect and generally enables to ensure a higher level of completeness, objectivity and thoroughness of investigation. The relevance of research is also confirmed by the fact that a full and objective establishment of circumstances of events to identify the mechanism of crime and guilt of participants while investigation can be ensured not only through identification research on video, sound recording, but also through diagnostic one.

**Analysis of Essential Researches and Publications.** Possibilities of diagnostics: information that can be obtained from video, sound recordings have been considered by such scientists, as V. L. Sharshunskyi, O. O. Lozhkevych, V. O. Snietkov, V. O. Chyvanov, Yu. V. Iashchurynskyi, V. X. Manerov, S. M. Vul, L. M. Cherniak, A. T. Hulak, V. I. Zakaretskyi, O. K. Dambrauskaite, O. K. Yermolaiev, V. M. Sorokin, S. L. Koval and others [1]. Their research is a significant contribution to the development of theoretical principles for the use of specific expertise in criminal proceedings. At the same time, the analysis of possibilities of forensic diagnostic research on video and sound recordings is an issue that currently should be thoroughly researched on.

The **Article Purpose** is to outline possibilities of diagnostic research on video and sound recordings through coverage of their classification, when conditionally by a research object, three directions of diagnostic research can be identified and described in the course of forensic audio and video analysis:

[1] E.g., Ложкевич А. А., Снетков В. А., Чиванов В. А., Шаршунский В. Л. Криминалистическое исследование звуковой среды, записанной на фонограмме : метод. пособ. Москва, 1981. 48 р. ; Ящуринский Ю. В. Криминалистическая диагностика звуковой среды : дис. … канд. юрид. наук. Киев, 1990. 327 р. ; Манёров В. Х. Успешность восприятия говорящего в зависимости от индивидуальных особенностей слушателей. *Вопросы психологии*. 1990. № 1. Р. 147—153 ; Вул С. М. Судебно-авторoведческая идентификационная экспертиза : метод. пособ. Харьков, 2007. 64 р. ; Дамбраускайте О. К. Использование особенностей профессиональной лексики при исследовании анонимных документов. *Вопросы судебной экспертизы и криминологии*. 1982. Вып. 16. Р. 41—49 ; Сорокин В. Н., Макаров И. С. Определение пола диктора по голосу. Обработка акустических сигналов, компьютерное моделирование. *Акустический журнал*. 2008. Т. 54. № 4. Р. 659—668 ; Коваль С. Л., Панова Е. А. Экспертный метод диагностики биологических параметров диктора по голосу. *Труды Международной конференции «Диалог 2007».* Наро-Фоминск, 2007. Р. 263—268.

- study of direct speech information which may contain information about the identity of a person in question;
- technical studies containing information about the technology of obtaining / recording / storing video, sound recordings, properties and features of data carrier itself;
- research on non-speech information (namely, the sound environment which combines information about sound sources by acoustic phenomena accompanying the process of video, sound recording, or directly associated with a situation of an offense event).

**Main Content Presentation.** An offense event should always be determined as an event taking place in a particular environment conditioned by spacetime properties. The task of the forensic research on sound environment, as well as forensic cognition of an offense event in general, are due to the tasks of procedural proof, that is while criminal proceedings, an offense event, time, place, a way of committing a crime, a guilty person, etc. should be proven.

The audio environment of an offense event is a single system of sound traces of natural and artificial sources of origin, subjective-communicative activity of an offender, tools, instruments and technical tools for committing crimes used by the offender and united with a common goal. Fulfillment of the above goal is due to the nature and durability of effects on the object of an offense event, as well as unity of a place (space) and manner of its achievement [1]. Legally speaking, the peculiarity of the analysis of the sound environment while investigating an offense event lies in the fact that such research enables to prove many facts of criminal activity taking place face-to-face, without witnesses. During offense commission, its participants facilitate interaction between means of criminal activity (explosive devices, weapons, tools) and physical environment, and thus a set of sounds that forms the sound environment of a crime emerges.

Oftentimes, law enforcement agencies are addressed with anonymous reports on certain events; for example, facts of sabotage, threats, offenses, bullying presented as reports on bombing of certain facilities, etc. For some reason, "authors" of such reports are reluctant to reveal their personality, thus further complicating investigation of such offenses. In such circumstances, there is an urgent need to study video and audio recording to find all possible data about the unknown speaker. Obtained information about the identity of the unknown speaker provides an opportunity to more effectively identify and search for a particular person, reduce the number of persons who are the subject to inspection, thereby reduce the time of offense investigation. In addition, recorded non-verbal sounds from various sources (street noise; sounds of working mechanisms; different signaling devices) accompanying oral speech (the so-called sound environment) can be used to prove various facts and circumstances associated with an offense event. Separately, let's note that the range of circumstances that can be determined by expert researches keep constantly expanding.

[1] Ящуринский Ю. В. Op. cit.

***Regarding diagnostic research directly on speech information.*** The audio content of recordings containing speech information and information about the sound environment is analyzed by ear. The hearing range and experience of acoustic diagnostics under certain skills enable to distinguish necessary elements from the sound environment, evaluate and determine their belonging to a specific group of sound phenomena [1]. At the same time, let's emphasize that no matter which accurate measuring instruments and sound visualization methods are used by forensic experts, the conclusion of video and sound recording examination begins to be formed and finalized only considering auditory perception of sound information recorded in a sound record (verbal and nonverbal nature of origin).

Diagnosis of directly verbal information includes the definition of: forms of oral speech, nature of relations between interlocutors, meaning of conversation content, speech tempo and emotional state of interlocutors. First of all, forensic experts determine the number of speakers, i.e. whether the speech is the statements of only one person or the conversation of two, three or more people. One person's statement can be a story about what they saw, a report, lecture, speech at a meeting, etc. During a conversation of two or more people, statements may influence each other, be combined, interact, complement each other, several topics of conversation may develop simultaneously, etc.

The nature of the relationship between participants of a conversation is determined, considering circumstances of a case (proceeding), analysis of the content and manner of statements. Generally, there are three types of relationships: formal, neutral and close.

By a voice tone, intonation and content of conversations you can also establish an emotional state of a person at the time of conversation: calm, even, irritable, depressed, joyful. Fundamental emotions, according to K. Izard [2], can be called:

1) interest — anxiety;
2) joy;
3) surprise;
4) grief — suffering;
5) anger;
6) disgust;
7) contempt;
8) fear;
9) shame;
10) guilt.

All other emotions are their derivatives and combinations. Usually, an emotional state of a speaker is indicated in an expert conclusion as a commentary.

[1] Ложкевич А. А., Снетков В. А., Чиванов В. А., Шаршунский В. Л. Op. cit.

[2] Изард К. Эмоции человека : монография ; пер. с англ. под ред. Л. Я. Гозмана, М. С. Егоровой. Москва, 1980. 439 р.

Human oral speech is characterized by acoustic and linguistic features, which, while being individual and constant, help us not only to repcreate an approximate appearance of a person who is speaking but also to identify it. By a person's oral speech we can establish the place of stay, education, intellectual level, communication skills, temperament, emotional state at the time of conversation, psychological traits of a speaker, his socio-professional belonging, the circle of his communication, age, gender, certain anthropological data, nationality, speech defects (burring, snuffling, lisping), etc. Practice has demonstrated that particular biological parameters of the speaker (sex, age, height, weight) can be determined fairly accurately by his speech. However, expert diagnosis of biological parameters of those speakers who have non-standard temperament parameters is more complex and requires special training of forensic experts. An issue on the officially certified characteristics of the speaker: biological (sex, age, height, weight) and social (native language, place of language skills formation, education, profession and social environment or social belonging) indicate only corresponding (potential) social and biological characteristics of a person being inspected, that are characteristic of a relevant category of people.

Diagnostic research on the establishment of conversation meaning includes detection of a content situation: agreement — disagreement; permission — prohibition; understanding — misunderstanding; request; advice; promise; assurance; gratitude; threat; clarification; order; question; report; etc.

***Regarding diagnostic technical researches*** on recording media and equipment, which may contain information on the technology of receiving/recording/storing video, sound recordings, properties and features of a data carrier itself. The essence of this type of forensic examination of video and sound recording is to carry out researches on technical means of receiving/transmitting/recording/storing visual and additive information and its carriers. The following studies are performed to establish: technical specifications and technologies for video and audio recording (in particular, recording system (mechanical, optical, magnetic), method (analog or digital)); the fact of copying, re-recording or duplication; signs and methods of editing; technical specifications of recording, the existence of defects, damage, etc. as well as (for the purpose of diagnosing recording devices, means of their manufacture) to determine the technical condition of video, audio and their components, nature of faults, probable causes, etc. Thus, for example, in the practice of criminal offense investigations while forensic video, audio analyses and devices for their creation, professionalism of a person who conducted a sound recording is determined, age of records, initial condition of a studied sound record is restored.

At the same time**, *issues of forensic diagnosis of the sound environment*** should be viewed separately. Auditory perception is most often associated with visual perceptions of what is happening. The sound environment of a studied sound record allegedly transports the listener to the environment characteristic of this sound background: a stadium, room with open windows, long corridor,

underground station, countryside, etc. The sound environment (noise level, existence of certain sound sources, frequency of sound vibrations) inherent in each real situation along with the language situation help us to draw conclusions about the environment by its sound manifestations based on our own experience and auditory memory.

In general, non-verbal sounds according to their belonging to certain sources can be classified as follows:

- sounds typical of natural sources of a sound:
  a) nature sounds (voices of birds, animals, noise of wings, noise of animals movement, etc.), in particular, sounds inherent in the human person (noise of steps, hands clapping, non-verbal sounds of movement, etc.);
  b) sounds of inanimate nature (wind, thunder, surf noise, leaves rustle, etc.);
- sounds produced by machines, apparatus, devices:
  a) sounds of musical instruments;
  b) sounds of TV, radio broadcasting, reproduction;
  c) siren sounds, alarm systems, alerting systems, etc.;
  d) sounds of communication devices (phone calls, messengers), clockwork, etc.;
- sound vibrations, functionally characteristic of mechanisms, machines, appliances:
  a) sounds of industrial mechanisms (machine tools, cranes, presses);
  b) sounds of vehicles;
  c) sounds of household appliances (vacuum cleaner, refrigerator, electric razor);
  d) sounds of electric and hand tools (electric drill, hacksaw, lawn mower, etc.);
  e) sounds of office equipment (office equipment, printer, scanner, keyboard, cooler);
- sounds characteristic of objects for non-intended purpose:
  f) falling objects, car body hits, etc.;
  g) use of household items (dishes shattering; fallen coins jangling; the sound of the door opening/closing; a bridge creaking, etc.).

The answers to the questions of forensic diagnosis of the sound environment are primarily based on an integrated analysis of the characteristics of those sound sources (mostly of technical origin) that make up the sound environment of an offense event.

**Conclusions.** Summarizing the above, in forensic diagnosis can be used both information that can be obtained about a person's personality by sound records with a speech, and information about the acoustic environment (chronology of events that take place), about non-verbal sources of sound signals (a phone being dialed, sources of noise or musical obstacles, etc.), determination of acoustic conditions and circumstances of sound record production.

The conducted research allows to distinguish and classify data of results of diagnostic researches on video and sound recording which:

- can be used to obtain information about traits and condition of a speaker by his oral speech;
- may contain information about a technology of receiving / recording/ storing video and sound recordings, properties and features of the data carrier itself;
- can store information about the sound environment: sound sources by their acoustic characteristics that are directly associated with a situation of an investigated offense event.

The conducted research does not exclude all possibilities of forensic diagnostic research on video and sound recordings, and only confirms the necessity of performing further detailed and thorough researches in this direction.

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***О. І. Брендель***

**Сучасні можливості діагностичних досліджень у криміналістичній експертизі відео-, звукозапису**

*Висвітлено одне з важливих питань кримінального судочинства — використання даних, здобутих у результаті діагностичних досліджень відео-, звукозаписів, що дає змогу забезпечити більш високий рівень повноти,*

*об'єктивності й усебічності розслідування. Метою статті є аналіз можливостей діагностичних досліджень записів як усного мовлення, так і звукового середовища події правопорушення. Розглянуто різноманітні можливості таких досліджень. Звернено увагу як на особливості діагностичних досліджень мовлення з метою отримання інформації про особистість невідомого, так і на відомості, які можна здобути діагностуванням немовленнєвої інформації.*

***Ключові слова:*** *судова експертиза відео-, звукозапису; звукове середовище; діагностичні дослідження; немовленнєві сигнали; дослідження; мовлення.*

***О. И. Брендель***

**Современные возможности диагностических исследований в криминалистической экспертизе видео-, звукозаписи**

*Освещены вопросы, всё чаще возникающие в уголовном судопроизводстве, а именно: использование данных, полученных в результате диагностических исследований видео-, звукозаписей, что в целом позволяет обеспечить более высокий уровень полноты, объективности и всесторонности расследования. Целью статьи является анализ возможностей криминалистических диагностических исследований видео-, звукозаписей как устной речи, так и звуковой среды события правонарушения. Рассмотрены современные разнообразные возможности диагностических исследований видео-, звукозаписей. Обращено внимание как на особенности диагностических исследований речи с целью получения информации о личности неизвестного, так и на сведения, которые можно получить благодаря исследованию и диагностике неречевой информации. Проанализированы возможности (в рамках проведения экспертизы видео-, звукозаписи) диагностических исследований непосредственно речевой информации, которая включает определение: формы устной речи, характера отношений между собеседниками, смысла беседы (определение содержательной ситуации: согласие — несогласие; разрешение — запрет; понимание — непонимание; просьба; совет; обещание; заверение; благодарность; угроза; разъяснение; распоряжение; вопрос; сообщение и т. п.), темпа речи и эмоционального состояния собеседников, а также экспертную диагностику биологических параметров дикторов. Рассмотрены возможности диагностических исследований технических исследований носителей записи и аппаратуры записи, которые могут содержать сведения о технологии получения/фиксирования/сохранения видео-, звукозаписей, свойств и особенностей непосредственно самого носителя. Классифицированы неречевые звуки по их принадлежности к определённым источникам. Освещены эффективность использования полученной экспертизой криминалистической информации в практике расследования преступлений.*

***Ключевые слова:*** *судебная экспертиза видео-, звукозаписи; звуковая среда; диагностические исследования; неречевые сигналы; исследования; речь.*

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**Contributor**
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