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Criminalistic potential of machine learning methods in recognizing psychophysiological reactions of participants in investigative interrogations

This study provides a comprehensive assessment of the forensic potential of machine learning methods for recognizing and interpreting the psychophysiological reactions of participants in investigative interrogations in the context of the digitalization of criminal proceedings. The research is based on the analysis and synthesis of foreign empirical studies, as well as on comparative and formal-logical methods, and includes a systematic review of contemporary computer vision and deep learning algorithms used to analyze facial microexpressions and nonverbal behavior. Empirical evidence from studies conducted by Chinese, American, and Dutch researchers demonstrates that intelligent algorithms are capable of reliably detecting facial microdynamics, indicators of anxiety, and emotional instability, in some cases exceeding the consistency of human observation. At the same time, the findings indicate that algorithmic outputs cannot function as autonomous sources of evidence. The study substantiates the need for normative and methodological adaptation of these technologies to domestic forensic practice in the Republic of Kazakhstan, taking into account evidentiary standards, procedural safeguards, and human rights protection. It is concluded that the phased and explainable integration of machine-based psychophysiological analysis into existing forensic psychological and criminological examinations is both feasible and methodologically justified.

Keywords: algorithm, interrogation, forensic science, machine learning, facial expressions, neural network, pattern, anxiety, forensics, emotions.

Introduction

Modern computer forensics [1] is undergoing a phase of rapid digitalization, a process that has long since moved beyond the mere automation of routine operations. Generative artificial intelligence *(hereinafter referred to as AI)* is gradually becoming a practical working tool that not only facilitates the organization and storage of analytical information but also enables deeper examination of an individual's psychophysiological state and the characteristics of emotional expression. The relevance of the present study is **driven by** the fact that generative AI and machine learning methods are increasingly being integrated into the analysis of digital traces; however, their application to the assessment of psychophysiological reactions of participants in investigative interrogations remains theoretically and methodologically underdeveloped. At the same time, as the volume of video and audio data obtained during investigative activities grows rapidly, traditional expert approaches demonstrate limited capacity to identify subtle and short-lived behavioral and emotional indicators.

AI systems are capable of processing data sets that were previously analyzed manually while simultaneously detecting fine-grained details that may remain unnoticed even by experienced forensic experts. These include complex and dynamic behavioral patterns (from the English pattern, meaning "form, model, template, or habitual mode of thinking and behavior") [2], as well as subtle psychophysiological indicators manifested in human behavior. Such elements serve as an important complement to traditional forensic methods, allowing for more accurate situational assessment, the formulation of investigative hypotheses, and their subsequent empirical verification [3].

This technological advancement fundamentally reshapes approaches to the evaluation of evidence in criminal investigations. Forensics becomes more flexible, multilayered, and efficient, while forensic experts gain the opportunity to combine their professional experience with the analytical capabilities offered by machine-based analysis. At the same time, this stage gives rise to a methodological and practical challenge: despite the high accuracy of machine learning algorithms, there is no unified understanding of how the results of automated analysis should be interpreted, validated, and used as evidentiary information within criminal

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proceedings. As a result, a new methodological framework is emerging in which humans and AI interact not as operator and tool, but as complementary participants in the forensic process.

One of the most advanced and promising areas of digital forensics is the analysis of behavioral patterns and psychophysiological reactions [4]. This approach goes beyond the mere recording of observable human actions and seeks to uncover the underlying logic of behavior, emotional fluctuations, and characteristic responses in stressful or conflict situations. Nevertheless, both forensic theory and practice continue to face a significant gap associated with the lack of validated tools and methodological criteria for the use of such technologies in forensic expert activity.

Recent studies demonstrate that machine learning methods—particularly those based on the dynamic recognition of micro-expressions—enable the detection and interpretation of subtle facial movements that typically escape conscious human perception. These algorithms operate on high-frequency video data, capture minimal muscular impulses, and correlate them with emotional patterns derived from large-scale datasets [5].

At the international level, a pivotal role has been played by the Dynamic Facial Micro-Expressions platform *(hereinafter referred to as DFME)* [6], which was specifically developed to train neural networks on detailed recordings of micro-movements of facial muscles. DFME has become a benchmark resource for the analysis of behavioral patterns and human psychophysiological reactions, as it integrates meticulously annotated video sequences, covers a wide range of emotional responses, and provides forensic experts with a reliable framework for testing new models of human psychophysiological behavior. Owing to such resources, the quality of automated micro-expression analysis has improved significantly, and these methods have evolved into tools capable of operating in situations where human perception alone proves insufficient.

Within the criminal procedural context, this technology offers the prospect of objectively assessing the emotional responses of participants in pre-trial investigations, including indicators of stress, anxiety, or deceptive statements. In this regard, particular importance is attributed to an interdisciplinary domain that integrates forensic science, forensic psychology, and artificial intelligence.

The use of neural network-based algorithms for interpreting DFME data requires not only technical but also legal adaptation, specifically the formulation of admissibility criteria for digital evidence, the development of methodologies for expert verification, and the ethical regulation of automated emotion analysis.

Despite the rapid advancement of computer vision technologies, existing systems for facial expression and emotional response analysis in investigative and judicial practice have not yet received normative or methodological institutionalization. In domestic forensic science, there is currently no validated toolkit for identifying the psychophysiological reactions of interrogated individuals using AI technologies. Moreover, the question of the reliability boundaries of machine-based interpretations remains unresolved.

Studies conducted by foreign scholars in the field of visual psychophysics [7] indicate that machine vision algorithms often outperform humans in interpreting facial patterns; however, they require explainability and reproducibility of their decision-making processes.

These issues are particularly salient for forensic examinations, where any automated conclusion must be transparent and verifiable. At the same time, as noted by researchers from the Faculty of Social and Behavioural Sciences at Utrecht University [8], even experienced observers frequently fail to reliably assess levels of anxiety or nervousness based on facial dynamics, whereas computer vision algorithms successfully address this task. This observation highlights the cognitive limits of human perception while simultaneously pointing to the potential of AI to reconstruct an individual's psychophysiological state from video recordings of interrogations.

Consequently, a clear scientific and practical gap exists between the technical capabilities of contemporary machine learning models and their applicability within domestic forensic practice. There is currently no systematic understanding of how the results produced by such algorithms should be interpreted, verified, and employed as evidentiary information or how their probative value should be assessed.

The authors adopt a critical stance toward the uncontrolled implementation of artificial intelligence algorithms in investigative practice and proceed from the premise that machine-based analysis of psychophysiological reactions cannot be regarded as an independent source of evidence. At the same time, provided that such technologies are subject to methodological formalization, normative regulation, and expert verification, they are capable of significantly enhancing the objectivity and reproducibility of forensic psychological and criminological examinations by complementing—rather than replacing—the professional judgment of the expert.

The purpose of the present study is to reveal the forensic potential of machine learning methods in recognizing the psychophysiological reactions of participants in investigative interrogations, as well as to substantiate the possibility of their integration into the system of evidentiary evaluation and forensic expertise in the Republic of Kazakhstan.

To achieve this objective, the study seeks to address the following tasks:

1. To analyze existing approaches to the automated recognition of facial micro-expressions, including DFME as a new benchmark for the dynamic analysis of facial behavior.

2. To examine the concept of *"visual psychophysics"* as a framework for ensuring the explainability of machine learning algorithms in the context of law enforcement and judicial practice.

3. To identify the capabilities and limitations of computer vision technologies in assessing states of anxiety and stress during investigative interrogations.

4. To formulate proposals for incorporating machine learning methods into the domestic methodology of *"forensic psychological and criminological examination"* [9], while ensuring their legal validity and ethical admissibility.

Thus, the present research is aimed at advancing the theoretical foundations of "*digital forensics"*, in particular by developing a scientifically grounded approach to harnessing the potential of machine learning for the recognition of psychophysiological behavioral indicators during investigative activities, including interrogations.

Methods and materials

The methodological framework of the study is based on systemic, comparative-analytical, and interdisciplinary approaches. The research employs methods of forensic analysis, visual psychophysics, machine learning, and computer vision. Comparative analysis was conducted using empirical data from three research domains: dynamic facial micro-expressions (People's Republic of China), algorithmic robustness to distortions (United States), and automated anxiety recognition (the Netherlands).

Both quantitative and qualitative methods were applied to compare the accuracy of machine learning models with human observational assessments. The empirical dataset included facial action coding system (FACS) data, dynamic parameters of facial muscle activity, and algorithmic response curves to visual distortions. The results obtained were interpreted within the context of law enforcement and judicial practice, which made it possible to formulate proposals for the normative integration of AI methods into forensic expert activity.

Results

The Results section presents an analytical review of several groups of empirical data. First, experimental materials on the dynamics of facial micro-expressions based on the new benchmark DFME dataset developed by specialists in computer science and technology at the University of Science and Technology of China (hereinafter referred to as the PRC) [10] are examined. Second, the methodology for assessing the robustness of algorithms to psychophysical facial distortions proposed by researchers from the University of Notre Dame [7] is analyzed. Third, studies conducted by scholars from the Faculty of Social and Behavioural Sciences at Utrecht University are reviewed, focusing on the machine-based recognition of psychophysiological indicators of anxiety using audio and video recordings of interrogations [8].

Based on the entirety of the reviewed analytical materials, a comparative statistical assessment was carried out to contrast human observational judgments with the outputs of machine learning algorithms. This comparison was aimed at developing a scientific approach to harnessing the potential of machine learning for recognizing psychophysiological indicators of human behavior during investigative activities, including interrogations. The integrated analysis of these data blocks made it possible to form a holistic understanding of both the capabilities and the limitations of applying machine learning algorithms in forensic practice.

In the first empirical data block, the authors analyzed experimental studies conducted by experts from the University of Science and Technology of China on the dynamics of facial micro-expressions using the newly developed DFME benchmark dataset [10]. These experiments made it possible to observe subtle dynamic changes in facial musculature that ordinarily remain beyond the limits of human perception. The dataset comprises video segments ranging from approximately one-twelfth of a second to about half a second in duration. Within these brief intervals, involuntary emotional reactions are captured, which are traditionally described in micro-expression research as manifestations of latent affective tension.

The dataset includes annotations of active muscle units according to the Facial Action Coding System (FACS) [11] for each frame, as well as spatiotemporal features that have been employed in the automated analysis of micro-expressions since the mid-twentieth century. These data enable objective assessment of minute displacements of muscle groups that collectively form the micro-dynamics of facial behavior.

Comparative validation of various algorithms on the DFME dataset reveals a wide dispersion in accuracy. Models based on different architectural approaches demonstrated performance metrics ranging from extremely low to near-high values. This variability is attributed to the fact that micro-expressions constitute weak and rapidly unfolding signals to which algorithms exhibit differing degrees of sensitivity. Accordingly, DFME can be regarded as a robust testing benchmark that demonstrates the extent to which a particular model is capable of capturing genuine micro-movements rather than random noise.

The second block of empirical data logically builds on studies of algorithmic robustness to psychophysical facial distortions proposed by a group of expert researchers from the University of Notre Dame (USA) [7]. This line of research is fundamentally important for forensic science, as it models distortions that commonly arise in video recordings of investigative actions, including camera shake, insufficient lighting, stress-induced micro-deformations, and short-term muscular spasms. A key outcome of this analysis is the demonstration that evaluating algorithmic performance without accounting for distortions inherent to real-world investigative video conditions leads to methodologically inflated conclusions regarding algorithmic reliability.

The research methodology is grounded in the concept of item-response curves. The Notre Dame researchers systematically altered image parameters by introducing noise, blurring, contrast reduction, and minor geometric distortions. Each type of transformation was applied along a progressively increasing scale, which made it possible to identify quantitative thresholds at which the algorithm loses the ability to reliably distinguish a human face. In addition, individual response curves were constructed for each algorithm with respect to specific distortion classes, capturing the precise point at which recognition fails. This approach provided not an averaged estimate, but rather an individualized vulnerability profile of the algorithm [7].

Prior to constructing the response curves, the researchers performed biometric stratification based on the Doddington biometric menagerie principle, which allowed unstable cases to be excluded from the dataset and a group of robust identifiers to be isolated. This procedure increased the accuracy of the evaluation by eliminating the influence of inherently difficult-to-recognize faces that tend to generate high error rates even in the absence of distortions [12].

At the final stage, threshold values were calculated for each category of distortion. For example, in the case of blurring, a critical value of approximately 3-4 pixel radii was identified, beyond which the algorithm abruptly lost its ability to identify a human face. In contrast, noise-related distortions exhibited a more gradual degradation pattern, characterized by a progressive increase in matching errors. Taken together, these data made it possible to quantitatively assess the sensitivity of algorithms to the natural conditions of real-world video recordings of investigative interrogations, where psychophysiological stress manifests through pronounced micro-movements and transient facial deformations. The conclusion drawn is that such quantitative thresholds are of fundamental importance for forensic science, as they define the boundaries of acceptable trust in automated analytical systems when working with interrogation video materials.

Accordingly, this type of analysis constitutes a foundational basis for comparative assessment between the capabilities of human observers and those of machine learning algorithms. In the context of investigative actions, these findings are particularly significant, as they clarify the conditions under which a forensic expert may rely on automated systems and when it becomes necessary to revert to direct visual analysis by the specialist.

The third group of empirical data concerns the analysis of psychophysiological indicators of anxiety derived from audio and video recordings of interrogations. The most representative results are presented in interdisciplinary studies conducted by a research group at Utrecht University (the Netherlands), which examined the feasibility of automated anxiety recognition based on facial muscle dynamics and associated temporal time-series data [8].

The research group at Utrecht University (the Netherlands) conducted a study involving a sample of 154 voluntary participants, for whom interrogation-style video materials were recorded under controlled conditions. Using computer vision algorithms, indicators of activity for 17 basic action units were automatically extracted according to the Facial Action Coding System, and a set of derived dynamic parameters was subsequently computed. These parameters included the number of activation peaks for each action unit, their average duration, amplitude, and frequency of occurrence above an individual threshold defined as one

standard deviation. The total number of generated features exceeded three hundred, after which a predictor selection procedure was applied to exclude highly correlated variables.

The resulting anxiety models demonstrated a clear and consistent pattern. The correlation between model-predicted anxiety levels and participants' self-assessments proved to be statistically significant and high [8]. Regression weight coefficients identified several of the most informative components, including changes in action units 1 and action units 2 (inner and outer eyebrows), dynamic peaks of action unit 5 (upper eyelids), as well as composite derivative parameters reflecting the micro-temporal structure of facial activity.

In parallel, the performance of human observers was evaluated. Six experienced specialists independently assessed anxiety levels based on the same video recordings. The researchers compared these assessments with the outputs of the machine learning model and found that human ratings exhibited greater random variability and a weaker association with participants' self-reported anxiety levels. In contrast, the algorithm demonstrated a more stable and linear prediction profile [8].

Accordingly, the findings of the Dutch researchers enable the inclusion of both human observer performance and machine-based models in a unified comparative analysis. This is particularly important for subsequent comparison with empirical data on micro-expressions [7] and assessments of algorithmic robustness to psychophysical facial distortions [10], as discussed in the preceding sections.

The integration of all three groups of empirical data made it possible to formulate an original concept of multi-level assessment of psychophysiological reactions in forensic science. This concept is based on a combined approach that incorporates micro-expression analysis, evaluation of algorithmic robustness to psychophysical distortions, and comparative analysis of machine-based and human observational results. The novelty of the findings lies in the comprehensive forensic reinterpretation of previously fragmented foreign empirical data and their integration into a unified analytical framework oriented toward the needs of forensic expert practice.

The results obtained directly correspond to the stated aims and objectives of the study, as they demonstrate both the potential of machine learning methods for recognizing psychophysiological reactions of participants in investigative interrogations and the objective limitations of their application. It is concluded that machine learning algorithms should be regarded not as autonomous sources of evidentiary information, but as auxiliary expert tools that enhance the objectivity and reproducibility of forensic psychological and criminological examinations, provided that their use is subject to appropriate normative and methodological regulation.

Discussion

The results obtained clearly indicate that contemporary machine learning algorithms no longer merely compete with human observers in facial expression recognition, but demonstrate greater stability and predictability in accuracy. This conclusion is supported both by experiments on dynamic micro-expressions based on the DFME benchmark dataset [10] and by studies on algorithmic robustness to psychophysical image distortions conducted by researchers at the University of Notre Dame [7]. Additional support for these findings is provided by data from Utrecht University, which show that humans make substantially more errors when assessing anxiety from interrogation video recordings, whereas algorithms maintain a consistent prediction profile and exhibit a linear relationship with participants' self-reported anxiety levels [8].

At the same time, the findings of the present study allow for clarification and partial reconsideration of the conclusions drawn in the aforementioned works. While technical and psychological studies primarily emphasize the superior accuracy of algorithms, this factor cannot be considered in isolation within a forensic context. Although it is reasonable to agree with foreign researchers regarding the high sensitivity of machine learning models to facial micro-dynamics and anxiety-related indicators, the authors do not endorse an approach in which algorithmic interpretations are treated as self-sufficient analytical outcomes without due consideration of legal and procedural constraints.

When all three empirical data blocks are examined together, it becomes evident that machine-based analysis occupies a distinct niche precisely where human perception encounters natural limitations—such as weak visual signals, high-speed micro-movements, the influence of stress factors, and suboptimal recording quality. This observation leads to a key conclusion of the study: AI is capable of more reliably capturing psychophysiological indicators associated with the internal reactions of interrogated individuals; however, the results it produces require normative and methodological adaptation to the national legal system.

From the authors' perspective, these findings should be interpreted within the framework of a scientific concept of limited and explainable integration of artificial intelligence into forensic expert practice. Under this concept, machine learning algorithms are not regarded as independent sources of evidence, but rather as auxiliary analytical tools that expand the expert's capabilities in diagnosing psychophysiological states. Such an approach is consistent both with the principles of visual psychophysics, which emphasize transparency and reproducibility of algorithmic decisions, and with the traditional tenets of forensic science that prioritize expert judgment.

Domestic forensic doctrine has not yet proposed a concrete mechanism that would allow forensic experts to use algorithmic interpretations as an evidentiary resource. The current Rules for the Organization and Conduct of Forensic Examinations [9] contain no references to digital behavioral patterns or to the admissibility of data extracted by computer vision algorithms. At the same time, the very nature of forensic psychological and criminological examinations already presupposes work with dynamic video recordings that reflect an individual's psychophysiological state [9]. In other words, a normative framework does exist, but it was developed prior to the emergence of these technologies and therefore requires adaptation to reflect them.

It is precisely at this juncture that an opportunity arises for the development of domestic forensic doctrine. First, national practice has traditionally been grounded in the principles of verifiability and reproducibility of expert conclusions. Data derived from visual psychophysics and item-response curves provide exactly such an instrument, as they delineate the boundary between an algorithm's "confidence zone" and the onset of probable error. This transforms machine-based analysis from a "black box" into a transparent and reproducible procedure. As emphasized by scholars in visual psychophysics, the explainability and transparency of algorithmic decisions constitute a key prerequisite for their legal acceptability in law enforcement practice.

Second, domestic forensic science has consistently emphasized interdisciplinarity, whereby psychological, forensic, and technical knowledge are expected to operate in conjunction. The nature of micro-expressions and anxiety dynamics lies precisely at this intersection, while machine learning algorithms merely assist in revealing phenomena that are already inherent to human psychophysiology. In this sense, AI does not function as an independent source of evidence, but rather as a tool that expands the analytical capacity of the expert.

Third, the integration of AI into forensic expertise inevitably requires an ethical filter. It is impermissible to create tools that could evolve into a "lie detector 2.0." Both Kazakhstani doctrine and international practice converge on the position that automated determinations of the truthfulness of testimony are untenable. However, automated analysis of emotional dynamics may be acceptable, provided that the forensic expert treats such outputs as auxiliary information rather than as definitive conclusions regarding an individual's motives or intentions.

In essence, the logic of the discussion leads to the conclusion that the results obtained confirm the forensic value of analyzing facial micro-movements and psychophysiological reactions. At the same time, the integration of such data into practice is possible only under the simultaneous conditions of scientific validity, normative clarity, and ethical caution. The doctrine of the Republic of Kazakhstan possesses all the necessary prerequisites to consistently address these issues and to incorporate this analytical toolkit into the existing system of forensic examinations, at least with respect to diagnostic tasks.

Conclusions

Based on the analysis conducted, it can be stated with confidence that machine learning methods focused on the study of facial micro-dynamics and other psychophysiological reactions are already capable of significantly enhancing forensic expert work in the examination of video recordings of investigative actions. Empirical evidence demonstrates that algorithms are more effective in detecting subtle emotional fluctuations, exhibit greater robustness to noise and distortions, and in certain cases provide more stable results than human observers. However, their practical application requires a gradual and regulated integration into the domestic legal framework and existing expert methodologies.

The normative basis of forensic examinations, as established by Rules No. 484 [9], provides a sufficiently solid foundation that permits the use of technical means when working with video materials. Nevertheless, this framework remains insufficient for algorithmic analysis of psychophysiological states, thereby necessitating an update of methodological approaches and clarification of procedural requirements. This does not entail the creation of a new type of forensic examination, but rather an expansion of analytical tools with-

in the existing framework of forensic psychological and criminological expertise, which fully corresponds to its objectives of assessing an individual's emotional and volitional state.

In light of the results obtained and the requirements of regulatory acts, the following steps appear appropriate:

1. Introduce a category of algorithmically extracted psychophysiological indicators.

Experts should be permitted to document facial micro-movements, muscle unit activity, amplitudes, frequencies, and reaction peaks. These data should not constitute independent evidence, but rather serve as supplementary factual material interpreted by the expert in conjunction with other case information.

2. Develop a methodology for algorithm verification based on visual psychophysics.

Prior to application, the expert should assess the model's robustness to image distortions and determine the boundaries within which algorithmic outputs remain reliable. This approach is consistent with the principle of reproducibility enshrined in the Rules on forensic examinations [9].

3. Establish requirements for algorithm explainability.

Only models providing access to feature weights, interpretable activation maps, and error metrics should be admitted for use. This prevents reliance on "black box" systems that cannot be subjected to verification or legal evaluation.

4. Strictly distinguish emotional dynamics from the veracity of statements.

Algorithms may detect anxiety, stress, or emotional tension, but must not render conclusions regarding deception or threat. This corresponds to the limits of expert competence, which excludes legal assessment of case circumstances.

5. Formalize a dual-assessment procedure.

The expert and the algorithm should produce independent assessments, followed by comparative evaluation. In cases of significant divergence, the expert must justify the discrepancies and conduct additional analysis.

6. Expand the list of admissible technical tools.

Given that video recordings constitute the object of examination (para. 330 of the Rules) [9], it is reasonable to include computer vision algorithms among permissible tools, provided that all processing stages are documented and the original recordings are preserved.

7. Develop an ethical code for working with emotional data.

Such a code should prohibit conclusions about personal traits or beliefs, limit the use of results strictly to the scope of expert tasks, and require mandatory disclosure to the court of the method's reliability boundaries.

The scientific value of this study lies in substantiating the concept of limited and explainable integration of artificial intelligence into forensic psychological and criminological expertise. Within this framework, machine learning is viewed as a means of expanding the expert's analytical capabilities while preserving the principles of verifiability, reproducibility, and procedural admissibility of expert conclusions.

The practical significance of the research consists in the potential application of its findings to improve methodological approaches to analyzing video materials of investigative actions, as well as to advance the normative regulation of digital technologies in forensic expertise in the Republic of Kazakhstan. The results may be utilized in forensic psychological examinations, in the activities of forensic institutions, and in educational and scientific programs aimed at training and professional development in the field of digital forensics.

Overall, it can be concluded that the integration of machine learning methods into forensic expert practice in the Republic of Kazakhstan is possible without undermining the existing system. On the contrary, with appropriate regulatory adjustments and transparent methodologies, algorithmic analysis may become a tool that enables forensic experts to assess the psychophysiological states of procedural participants with greater accuracy, efficiency, and objectivity. Such development aligns with contemporary trends in forensic science and strengthens the scientific foundations of domestic criminology.

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Тергеу жауап алуына қатысушылардың психофизиологиялық реакцияларын танудағы машиналық оқыту әдістерінің криминалистикалық әлеуеті

Мақалада қылмыстық сот ісін жүргізуді цифрландыру жағдайында тергеудің жауап алуына қатысушылардың психофизиологиялық реакцияларын тану және интерпретациялау барысында машиналық оқыту әдістерінің криминалистикалық әлеуетіне кешенді баға берілген. Зерттеу шетелдік эмпирикалық еңбектерді талдау және жинақтау, салыстырмалы және формальды-логикалық әдістерді қолдану, сондай-ақ бет әлпеті мимикасының микрокөріністерін және вербалды емес мінез-құлықты талдауға арналған заманауи компьютерлік көру мен терең оқыту алгоритмдеріне жүйелі шолу жасауға негізделген. Қытайлық, американдық және голландиялық ғалымдардың зерттеулерінен алынған эмпирикалық деректер интеллектуалдық алгоритмдер бет мимикасының микродинамикасын, мазасыздық пен эмоционалды тұрақсыздық белгілерін жоғары сенімділікпен анықтай алатындығын көрсетті, олар кейбір жағдайларда адамның субъективті бақылауларынан асып түседі. Сонымен қатар алынған нәтижелер алгоритмдік талдау қорытындыларының дербес дәлелдемелік ақпарат көзі ретінде қарастырылмайтынын айқындайды. Көрсетілген технологияларды дәлелдемелердің рұқсат етілу стандарттарын, іс жүргізу кепілдіктерін және адам құқықтарын қорғауды ескере отырып, Қазақстан Республикасының отандық сот-сараптама практикасына нормативтік және әдіснамалық бейімдеу қажеттілігі негізделеді. Психофизиологиялық жағдайларды машиналық талдаудың сот-психологиялық-криминалистикалық сараптаманың қолданыстағы түрлеріне кезең-кезеңімен және түсіндірмелі түрде енгізудің принципті мүмкіндігі мен әдіснамалық негізділігі туралы қорытынды жасалған.

Кілт сөздер: алгоритм, сұрақ алу, криминалистика, машиналық оқыту, мимика, нейрондық желі, паттерн, мазасыздық, форензика (соттық сараптама), эмоция.

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Криминалистический потенциал методов машинного обучения в распознавании психофизиологических реакций участников следственного допроса

В статье даётся комплексная оценка криминалистического потенциала методов машинного обучения при распознавании и интерпретации психофизиологических реакций участников следственного допроса в условиях цифровизации уголовного судопроизводства. Исследование основано на анализе и синтезе зарубежных эмпирических работ, применении сравнительного и формально-логического методов, а также систематическом обзоре современных алгоритмов компьютерного зрения и глубокого обучения, используемых для анализа микровыражений лица и невербального поведения. Эмпирические данные, полученные в исследованиях китайских, американских и нидерландских учёных, свидетельствуют о том, что интеллектуальные алгоритмы способны с высокой степенью надёжности фиксировать микродинамику мимики, признаки тревожности и эмоциональной нестабильности, в ряде случаев превосходя по устойчивости субъективные наблюдения человека. В то же время полученные результаты подчёркивают, что выводы алгоритмического анализа не могут рассматриваться как самостоятельный источник доказательственной информации. Обосновывается необходимость нормативной и методологической адаптации указанных технологий к отечественной судебно-экспертной практике Республики Казахстан с учётом стандартов допустимости доказательств, процессуальных гарантий и защиты прав человека. Делается вывод о принципиальной возможности и методологической обоснованности поэтапной и объяснимой интеграции машинного анализа психофизиологических состояний в существующие формы судебно-психолого-криминалистической экспертизы.

Ключевые слова: алгоритм, допрос, криминалистика, машинное обучение, мимика, нейросеть, паттерн, тревожность, форензика, эмоции.

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