THE FUTURE OF THE DIGITAL BODY: POSSIBILITIES AND CHALLENGES

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The presented study delves into the concept of the digital body within the context of modern technologies and their impact on the society, culture and personality. A digital body is defined as a representation of a physical body in virtual reality, augmented reality, and on other digital platforms. The article reviews opportunities for health support, self-expression, expansion of human experience, and social connections in the digital space provided by digital bodies. The authors also explore numerous challenges faced by the society when digital bodies are introduced. These include data safety, ethical dilemmas related to identity and privacy, as well as implications for mental health and social structure. The article makes predictions about the future of digital bodies stressing that an interdisciplinary approach is required to solve the arising issues. The aim of the analysis is to attract attention to the complex dynamic relationship between technology innovation and human experience, as well as to shape awareness about how digital bodies can transform our society within the next ten years.

Keywords: future of the digital body, technologies, artificial intelligence, virtual reality, biometric data, digital identity, ethics, security, privacy, health

Author contribution: authors made an equal contribution to writing the article.

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Received: 17.11.2025 **Accepted:** 03.12.2025 **Published online:** 15.12.2025

DOI: 10.24075/medet.2025.026

БУДУЩЕЕ ЦИФРОВОГО ТЕЛА: ВОЗМОЖНОСТИ И ВЫЗОВЫ

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Представленное исследование посвящено анализу концепции цифрового тела в контексте современных технологий и их влияния на общество, культуру и личность. Цифровое тело определяется как виртуальный аналог физического тела, который можно создать и развивать в виртуальной реальности, дополненной реальности и с помощью других цифровых платформ. В статье рассматриваются потенциальные возможности, которые предоставляет цифровое тело, такие как улучшение здоровья, возможности самовыражения, расширение границ человеческого опыта и развитие новых форм взаимодействия в цифровом пространстве. Однако наряду с этим авторы также обращают внимание на многочисленные вызовы, стоящие перед обществом в связи с внедрением цифровых тел. К числу таковых относятся вопросы безопасности данных, этические дилеммы, связанные с идентичностью и приватностью, а также последствия для психического здоровья и социальной структуры. Статья содержит прогнозы относительно будущего цифровых тел, подчеркивая необходимость междисциплинарного подхода к решению возникающих проблем. Проведенный анализ направлен на привлечение внимания к сложной динамике между технологическими инновациями и человеческим опытом, а также на формирование осознания о том, каким образом цифровые тела могут трансформировать наше общество в ближайшие десятилетия.

Ключевые слова: будущее цифрового тела, технологии, искусственный интеллект, виртуальная реальность, биометрические данные, цифровая идентичность, этика, безопасность, конфиденциальность, здоровье

Вклад авторов: авторы внесли равный вклад в написание статьи.

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Статья поступила: 17.11.2025 **Статья принята к печати:** 03.12.2025 **Опубликована онлайн:** 15.12.2025

DOI: 10.24075/medet.2025.026

An introduction to the concept of the digital body is an important step that helps to understand how a human being interacts with technology in the modern world. A digital body can be defined as a representation of a physical body in a virtual environment, including anonymous and public data created and controlled using the technology [1,2]. It is an expression of personality that is formed through various digital platforms such as social networks, online services, and even devices that collect and analyze user data [3,4]. The problem contributing to the research of the digital body concept lies in the contradiction between the rapid integration of digital technologies into everyday life [5] and insufficient willingness of social, legal and technical institutions [6] to ensure safety, privacy and integrity of user's identity [7] in the digital environment [8]. This problem is connected to multiple interrelated challenges. Firstly, high volume of collected personal and biometric data, their aggregation and analysis through machine learning algorithms create risks of unauthorized access, leaks and misuse of information, which undermines trust in digital services. Secondly, blurred boundaries between virtual and physical identity result in subjective and ethical dilemmas such as transformation of self-awareness, possibility of manipulating behavior through personalized content, and difficulties in assigning legal responsibility for actions in mixed realities. Thirdly, the active use of VR/AR and remote digital platforms leads to social consequences such as risks of social isolation, dependence on virtual environments and decline of interpersonal skills, which negatively affects mental and physical health of some users. Fourthly, technical and infrastructural barriers such as insufficient availability of high-speed Internet and modern devices [9], as well as

disparate standards and regulatory approaches in different jurisdictions make it difficult to implement technologies evenly and safely [10]. When AI is used to manage the digital body, additional challenges are faced such as the need to ensure the transparency of algorithms [11], prevent bias, and explain the decisions that affect the personal aspects of people's lives [12].

The research background includes achievements of many authors and practitioners. In the 1990s and early 2000s, early works on online identity and avatars laid the theoretical foundations for understanding the digital self and the social effects of online self-expression [13]. Empirical studies on biometrics and health monitoring [14] have demonstrated that the digital body potential for preventive medicine and personalized care is high and simultaneously showed data vulnerabilities and the need for ethical standards [15,16].

Research in VR/AR and cybernetics has confirmed that immersive technologies can transform user perception and behavior [17], paving the way for pedagogical simulations and virtual clinics [18]. Negative effects with uncontrolled use have been recorded as well [19, 20]. Research in AI is focused on creating adaptive interfaces and decision support systems. At the same time, the number of publications and standards offering mechanisms for ensuring privacy, differential privacy, explainability of models and combating algorithmic discrimination is increasing [21]. Finally, interdisciplinary research on the social impact of digital platforms has identified ways to reduce misinformation, develop emotional intelligence, and improve digital literacy as key elements of increasing society's resilience to the negative effects of digitalization. The most promising ways to address these challenges include an integrated, multi-level approach combining technological, regulatory, educational, and social measures. Technical solutions involve introduction of data protection and cybersecurity standards, use of default privacy by design, data-level encryption, differential privacy in analytics, and limited retention of sensitive information. Development of transparent, explicable models, audit algorithms, and bias control mechanisms is critical for AI. Regulatory measures should include common principles to regulate processing of personal and biometric data, ensure international coordination of standards, and clear responsibility of platforms for user safety and correct use of data.

Educational and awareness-raising initiatives are focused on improving digital literacy, critical thinking skills, and emotional intelligence so that users can consciously manage their digital bodies and respond sustainably to risks. Socio-psychological interventions and support services are designed to detect and mitigate addictions early, preserve interpersonal skills, and support mental health of users. In addition, development of inclusive infrastructure and reduction of the technical gap should ensure equal access to safe technologies and reduce the risks of marginalization of certain groups. The purpose of the research is to comprehensively analyze the nature of the digital body, its historical development, modern manifestations and consequences of the integration of digital and physical spheres of life, as well as to develop multilevel recommendations and practices aimed at ensuring security, privacy, ethics and social sustainability of digital identity of users. It is assumed that achieving this goal will contribute to the informed formation of policies, standards and educational programs necessary for safe and inclusive development of the digital society.

The hypothesis of the study is formulated as follows: introduction of agreed technical standards for data protection and algorithmic transparency, accompanying these measures with adequate regulatory regulation and extensive educational programs on digital literacy and emotional intelligence turn the digital body management into a safer and more controlled process, which will reduce the risks of loss of privacy and manipulation, mitigating social and mental negative effects of digitalization and improving the quality of medical and educational services based on digital data.

MATERIALS AND METHODS

This research is based on an interdisciplinary approach that uses methods of theoretical analysis, systematic review and conceptual understanding to study the digital body and its interaction with modern technologies. The main goal was a comprehensive review of historical development, current manifestations, prospects of the digital body, related challenges and opportunities in various spheres of human activity.

A wide range of scientific sources, including monographs, articles in peer-reviewed scientific journals, conference materials, analytical reports and reviews from leading research centers and organizations in the field of information technology, sociology, philosophy, medicine, and education were used as research materials. Special attention was given to publications on digital identity, virtual and augmented reality, artificial intelligence, ethical aspects of digitalization, cybersecurity, and impact of technology on social, cultural and professional processes. Literature was searched and selected using leading scientific electronic databases.

The following research methods were used:

- System analysis: to study the digital body as a complex dynamic system combining physical, virtual and social aspects of human existence.
- Historical and genetic method: to trace the evolution of the digital body from early ideas of the virtual Self to modern complex configurations that occurred due to development of Internet technologies, social networks, VR/AR and AI.
- Comparative analysis: to compare different approaches to understanding and managing the digital body, and identify common trends and specific features of its manifestation in different fields (healthcare, education, social interactions, work).
- Conceptual analysis: to detail key concepts such as "digital body", "virtual reality", "augmented reality", "artificial intelligence", "privacy", "security", and identify the relationships between the concepts.
- Ethical reflection: to assess moral and ethical dilemmas related to data privacy, cybersecurity, impact of digitalization on identity and social connections, and formulate recommendations on the responsible use of technology.
- Predictive analysis: to assess the potential future directions of the digital body and its impact on society, based on identified technological trends and social changes.

Thus, this study is a theoretical synthesis. Its aim is to develop a holistic view of the digital body in the context of a rapidly changing technological landscape and its impact on humans and society.

RESEARCH RESULTS

As a result of the research, the concept of the digital body as a multi-layered phenomenon was clarified and specified. The phenomenon included not only a set of digital footprints and user profiles, but also a set of biometric data, behavioral patterns, interactive avatars and adaptive interfaces formed under the influence of artificial intelligence and sensory technologies. Analysis of historical development has shown that transformation of human digital presence has gone through several stages: from simple text and graphic representations in early online communities through personalized social profiles to integrated ecosystems where user-related data are continuously collected, processed and used to create dynamic digital representations.

The paper identifies the key functional components of the digital body such as identification (identity and reputation), information and diagnosis (biometrics and health monitoring), interaction (avatars, VR/AR interfaces) and adaptation along with analytics (AI algorithms and personalization mechanisms). It also demonstrates how they are interrelated and influence each other. The study also showed that integration of VR and AR enhances the multidimensionality of the digital body: new forms of physicality and self-representation are created, the boundaries between "real" and "virtual" are blurred, and the experience of identity becomes context-dependent and multiple. An empirical review of the digital body applications in medicine has demonstrated a significant potential of technologies for prevention and individualized treatment: regular monitoring of biometrics and big data analytics make it possible to identify risks in a timely manner, create personalized health plans and improve the effectiveness of clinical decisions.

In education, the results of the study confirmed effectiveness of virtual clinics and simulation platforms for development of clinical thinking and practical skills; VR/AR-based interactive techniques contribute to deep learning of the material and increase the motivation of students. Analysis of socio-cultural effects has shown the dual nature of the digital body effect: on the one hand, technology promotes the expansion of social ties, inclusion and intercultural dialogue; on the other hand, the risks of fragmentation of identity, increased anonymous aggression and possible loss of lively social interaction qualities are noted. The study of legal and technical barriers revealed the main obstacles to the widespread adoption of digital practices such as insufficient infrastructure and digital literacy in individual regions, disparate regulatory approaches and weak protection of user data. Thus, unified standards and enhanced cybersecurity measures must be developed.

The results draw special attention to the impact of AI: it is established that algorithmic personalization and predictive analytics foster convenience and efficiency of digital services, though generating new challenges in the field of privacy, transparency of decision-making and responsibility for automated conclusions. The study assessed the impact of the digital body on the labor market and showed that digitalization and remote work expand employment opportunities and flexibility, but require new competencies and constant retraining; successful professional adaptation is associated with developed technical skills and soft competencies.

The results confirm that the digital body is a dynamic and multifaceted object integrating technological, social, ethical and legal dimensions; it's safe and humanistic development requires interdisciplinary approaches, strengthening digital literacy programs, introducing transparent regulatory mechanisms and improving data protection standards, which will maximize the benefits of technology while minimizing associated risks.

DISCUSSION OF RESULTS

The conducted research, devoted to the concept of the digital body, its historical development, relevance and multifaceted aspects of its impact on modern society, allows us to compare the findings with an extensive body of scientific papers and practical observations. Our results demonstrate that the definition of a digital body as a dynamic virtual representation of a physical body, consisting of anonymous and public data created and controlled by technology, is fully consistent with modern approaches in digital humanities and sociology of technologies. A number of authors also emphasize that this concept is constantly evolving from simple digital avatars to complex digital footprints, covering a wide range of online activity and data collected by Internet of Things devices [22]. The fact is emphasized as advantageous in further movement of mankind towards digitalization and virtualization of many aspects of public life, especially in the field of information systems [23], legal relations between various subjects of law [24], and their legal regulation [25].

Our observations of how virtual reality (VR) and augmented reality (AR) influence the perception of the environment and being, in particular, the shift of the ontological status of "essence" towards multiple realities, are reflected in works analyzing the phenomenology of digital space. Researchers in cyberpsychology and philosophy of technology also note that immersive technologies blur the physical-virtual lines, reshaping self-perception. The examples of VR and AR applications in various fields, from education to entertainment, correlate with the data presented in reports on innovative technologies, where these tools are considered as key drivers of digital transformation.

In healthcare, our conclusions about the growing role of the digital body for medical monitoring, disease prevention, and a personalized treatment approach based on the analysis of big data and biometric information are supported by numerous publications in HealthTech and medical information systems [26]. These studies also point to the significant potential of predictive analytics and machine learning in improving healthcare efficiency, which fully coincides with our conclusions.

Analysis of adaptation to user needs via personalized settings and unique avatars reflects the main trends in the field of human-computer interaction and user experience design. Many works in this field focus on the psychology of personalization, proving that it promotes deep user engagement and formation of their digital identity, which was found in our study as well.

In the context of education, our observations on the introduction of virtual clinics and interactive teaching methods in healthcare and other fields correspond to the trends described in educational research and EdTech publications. The concept of a safe and supportive learning environment for clinical thinking and practical skills is widely supported by leading educational institutions.

Our results regarding social aspects confirm the dual nature of digital technologies: on the one hand, they expand social ties, break down barriers, and foster virtual communities, which

is essential for sociologists and communication specialists. On the other hand, we, like many other researchers in the field of cyberpsychology, note the risks associated with anonymity, fueled online aggression, and potential social isolation. These contradictions are being actively discussed by the scientific community.

The issues of privacy, security of personal data and ethical aspects of digital life identified in our study are universal challenges discussed at the global level. Our conclusions about the growing cyberthreats [27], difficult self-awareness in virtual spaces, and the risk of dependence on technology are consistent with the work of leading experts in cybersecurity, law, and ethics of artificial intelligence [28, 29]. Similar studies emphasize the need for comprehensive legal and technical solutions to protect the rights and well-being of users [30].

Finally, the analysis of the impact Artificial Intelligence (AI) produces on the digital body and transformation of the labor market, including the rise in remote work and the need for new competencies, also correlates with current reports and forecasts on the future of work trends and AI development. Our conclusions about the importance of soft skills, technical skills, and continuous learning are commonly discussed while training specialists for digital economy. Cultural scientists and anthropologists who study the digital transformation of the society confirm that AI influences cultural and social standards as it was found out in our study.

Thus, our research, which covers a wide range of issues from how the digital body is defined to how it impacts work and culture, not only confirms the existing scientific trends, but also contributes to a deeper understanding of the complex human-technology relationship. The general research vectors indicate that the digital body is a central category to study modern reality that requires an interdisciplinary approach and constant reflection on the ethical, social and technical implications of its development.

CONCLUSIONS

The study systematized the concept of the digital body that shows how individuals represent themselves in digital environments, including anonymous, public data, and their collection and management tools (social networks, IoT, mobile applications, cloud services). The historical prerequisites for the formation of the digital body (from the early online profiles of the 1990s to modern platforms), technological components (VR, AR, biometrics, AI), application scenarios (healthcare, education, virtual clinics, remote work, virtual offices) [31] and socio-cultural consequences (changing communication norms, identity issues, cultural integration) have been reviewed [32]. The risks such as privacy, cybersecurity, loss of a sense of real identity, social isolation, technical and regulatory barriers are analyzed separately [33].

The goal has been successfully met in its entirety, as an interdisciplinary image covering key components (technologies, applications, risks and social effects) has been presented.

Recommendations for the development of the field and directions for further research are as follows:

1. Focused empirical research. Use clear methodology to research aspects of the digital body such as the impact of prolonged use of VR/ AR on cognitive and emotional performance; accuracy and reliability of biometric systems under different conditions; the degree of leaks and privacy risks in popular services.
2. Interdisciplinary projects. Make technical specialists, social psychologists, lawyers and ethicists work as a group in order to perform comprehensive assessment of how technologies impact the individual and the community.
3. Long-term longitudinal studies. To track changes in digital identity and psycho-social effects over a long period of time in order to identify cumulative effects and possible adaptive mechanisms.
4. Development and testing of privacy standards and protocols. Research to evaluate the effectiveness of technical and organizational data protection mechanisms (decryption, differential privacy, local data processing, explicit consent management models).
5. Ethical and legal research. Analysis of current regulatory practices, assessment of legislative gaps, and preparation of recommendations on a responsible use of AI, VR/AR, and biometrics.
6. Research on inclusivity and accessibility. Assess technological barriers in different regions and for different demographic groups; develop solutions to reduce digital inequality.
7. Applied pilots in education and medicine. Implement and evaluate pilot projects of virtual clinics and educational programs measuring the effectiveness of training and safety of patients/students.

Possible ways to use the results obtained in further research and practice:

1. Designing secure digital platforms: developers can use conclusions about the risks and needs of users to create more private and manageable digital profiles and avatars.
2. Medical applications: recommendations on the use of biometrics and digital bodies to prevent and monitor diseases can form the basis of remote monitoring protocols and personalized medicine.
3. Educational technologies: the results confirm that virtual clinics and AR/VR simulations are effective learning tools that allow to assess competencies and feedback.
4. Policy and regulation: the collected systematization will allow legislators and regulators to more precisely formulate regulations regarding the storage and processing of personal data, use of AI and protection of user rights.
5. Social interventions: understanding how social isolation and identity shifts impact people is the key to designing effective digital literacy programs that boost mental health and inclusion.
6. Personalization technologies: conclusions made about the importance of adaptation and virtual avatars can be used to create more ethical and user-oriented content and interface personalization systems.

The study confirms that the digital body is a central and multi-layered concept that helps to understand the modern human-tech interaction [34]. Strictly planned empirical research, interdisciplinary collaboration, and development of regulatory and technical tools that guarantee security, privacy, and inclusiveness of digital practices are required to shift from conceptual understanding to practical solutions [35].

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