Personal space and its transformations in a technological context

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Context and relevance of the research: The creation of autonomous computer agents and humanoid robots is becoming a priority subject of research in various fields of knowledge such as evolutionary psychology, cognitive science, neurobiology, engineering, social robotics, linguistics, philosophy, etc. The gap between technological, natural science and humanitarian-scientific discourse reveals the need for dialogue, scientific discussions, and the development of a common conceptual-categorical system in information technology and humanitarian knowledge. The expansion of the continuum of artificial realities actualizes anthropological problems, including the question of a new ontological status of human, of personal space, within which all aspects and projections of human existence undergo significant changes. Personal space as an ontological phenomenon of Self interacts with different environments (nature, society, culture, extended reality (XR)) has borders with them and in each partially functions. The research aims to develop methodological foundations for the study of personal space, formulate the author's definition of personal space, and identify conceptual methodological constructs to analyze the transformation of personal space in the development of information technology and social robotics. Used methodology: the principle of integrity, the principle of duality of being, typology of relations I-Thou and I-It by Martin Buber and Semyon L. Frank, system analysis, convergent approach. Key findings: The development of information technologies and social robotics has opened a new stage in forming the techno-

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logical context of human entry into symbiotic relations, where the boundaries between the natural and the artificial are blurred, which indicates the need to elaborate a convergent approach to studying interdisciplinary problems in technological and humanitarian knowledge. The author's definition of personal space as a holistic phenomenon of Self is offered for use as a methodological tool to study its changes in the technological context.

Key words: *autonomous computer agent, existential experience, extended reality (XR), human-robot interaction (HRI), I-Thou and I-It relations, personal space, social robot, technological context, transformations of personal space.*

Introduction

All eras have their intellectual *hot spots*[1]. Our time is marked by the rapid development of information technology, leading to creating different types of reality: virtual, augmented, mixed, digital, and others. Recently, a relatively new term, *extended reality (XR)*, has been introduced into scientific concepts, which covers virtual reality (VR), augmented reality (AR), and mixed reality (MR). However, there is significant variation in the definition of types of artificial realities. In terms of meaning, for instance, the conception of *augmented reality* is close to *mixed reality*. Both denote the interaction between a person, a computer, and various environments, combining actual physical world objects with virtual reality. There is already a plethora of research on *extended reality* (XR), mainly in technological solutions, and this area of knowledge with engineering and especially business proposals is growing exponentially[2]. Forecasts suggest that extended reality (XR) will become the predominant area for creating promising technologies that will dominate our lives in the next decade. Thus, a particular conceptual field is being formed – the *technological context* as a single semantic basis of information technology and its practical embodiment.

The main drawback in moving towards any single universally meaningful result in the study of the technological context lies in the fact that the problem is studied within each particular discipline's terminology. Thus, we encounter an unprecedented dispersion of approaches, method principles, hypotheses and conclusions, directly conflicting terminologies, and assessments. Such multivariate interpretations of studies of human-robot (or computer agent) interaction are mainly observed among representatives of humanitarian knowl-

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[1] David BROOKS, Foreword, in: John BROCKMAN (ed.), *This Will Make You Smarter: New Scientific Concepts to Improve Your Thinking*, (02.17.2012); https://www.edge.org (15.05.2021).
[2] Stephanie Hui-Wen CHUAH, Wearable XR-technology: literature review, conceptual framework, and future research directions. *International Journal of Technology Marketing*, 13 (2019) 3-4, 205-259.

edge, specialists in artificial intelligence, and engineering programming. The situation is complicated because, in computer science, the principle of anthropomorphism acts as the basis for the linguistic nomination. Hence, *anthropomorphic concepts* such as speech, emotion, empathy, reasoning, understanding, personality are often used to describe so-called *virtual humans*[3] and hyper realistic robots as elements of virtual human architecture or characteristics of humanoid robots. Grasping the metaphorical use of anthropomorphic concepts in computer science, David Burden, the author of more than 20 works on the virtual world and artificial intelligence, notes with some irony that these concepts so far reflect an illusion of wishful thinking, but in the future, they may well correspond to the meaning put into them. He writes:

> "A virtual human is, fundamentally, a computer program. In the far future, it may be something else, but for the foreseeable future, a virtual human is simply code and data which has been designed, and may be evolving, to give the illusion of being human".[4]

The gap between technological, natural science and humanitarian-scientific discourse reveals the need for dialogue, scientific discussions, and the development of a common conceptual and categorical system of research in information technology, social robotics, and humanitarian knowledge. An exciting experience in this sense is the creation of *Project Edge.org.* Its founder and editor-in-chief is John Brockman, a renowned science communicator. He organizes meetings, symposia, and online discussions of the most influential thinkers interested in cognitive science in conjunction with evolutionary psychology and information technology. According to David Brooks, this galaxy of scholars maintains the intellectual balance of the age[5]. The leaders of this scholarly community play a prominent role in rapidly evolving fields of knowledge and society. Brockman, through his project, pushes researchers beyond the boundaries of scientific disciplines, joining forces to develop a *convergent approach* to the complex problems of contemporary life, although, of course, scientific disciplines are essential to ensure methodological rigor. As a new problem field emerges, linking research in information technology, artificial intelligence, social robotics, and the humanities, there is an apparent lack of general theoretical and methodological research, which many academics point out when interpreting the results obtained within their discipline[6].

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[3] In this article, we will consider the term virtual people as a 21st-century phenomenon in the form of humanoid characters on a computer screen with embodied life-like behavior, which may include speech, locomotion, gestures, and movements of the avatar's head, eyes or other body parts.

[4] David BURDEN, Maggi SAVIN-BADEN, *Virtual Humans: Today and Tomorrow*, London, New York, CRC Press Taylor & Francis Group, 2019, 3.

[5] Brooks, *Foreword…*

[6] Jakub ZLOTOWSKI, Diane PROUDFOOT, Christoph BARTNECK, More Human Than Human: Does the Uncanny Curve Really Matter? *Proceedings of the HRI2013 Workshop on*

Expansion of the continuum of artificial realities, in which the human being exists nowadays, actualizes anthropological problems[7], including personal space research as an integral phenomenon of Self. There is a question of a new ontological status of an individual, their personal space, within the boundaries of which there are significant changes in all aspects and projections of human existence. The article aims to develop methodological foundations for the study of personal space, formulate the author's definition of personal space, to identify the conceptual methodological constructs for scrutinizing the transformation of personal space in the technological context.

1. Methodological foundations for the research of personal space

One of the most critical methodological foundations for the study of personal space is the philosophical and scholar *principle of integrity*. A person's personal space is an integral existential story with birth, socialization, personal dramas, ups and downs, desperate self-realization, and, finally, the end of life's journey. Both in space and time, this wholeness cannot be assembled or disassembled into pieces. It cannot be described purely rationally, let alone technically reconstructed, because personal space as an integral phenomenon of Self is an "incomplete possibility. Against, a virtual person is always a projection (part) of a real one, programmed for a specific technological task. IT specialists note that the digital copy of a real person is still far from the original[8].

Another methodological basis for the study of the personal space is the *principle of duality of the nature of all things*, consisting simultaneously in their unity and division. The famous thinker Martin Buber, in his philosophical work *I and Thou* (1957, translated from German, 1993) singled out two fundamental types of human relations to the world: *I-Thou* and *I-It*, which can be considered as *methodological tools* for the study of personal space.

The source of the *I-Thou* relationship is *natural interconnection (unity)*. The source of the *I-It* relationship is *natural separateness.* Buber noted that these

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Design of Humanlikeness in HRI from uncanny valley to minimal design, Tokyo, 2013, 7-13; Gabriella AIRENTI, The Development of Anthropomorphism in Interaction, Intersubjectivity, Imagination and Theory of Mind, *Frontiers in Psychology*, 9 (2018) 7-19.

[7] Sergej A. NIZHNIKOV, Radoje GOLOVICH, Dialektika A. F. Loseva i fenomenologiia [Dialectics of A. F. Losev and Phenomenology], *Voprosy filosofii*, 6 (2020) 116-125; Elena V. ZOLOTUKHINA-ABOLINA, Michael V. INGELEIH M. B., Ekzistentsial'nyi optimizm: usloviia, pliusy, problemi [Existential Optimism: Conditions, Pros, Problems], *Voprosy filosofii*, 3 (2021) 18-28.

[8] Burden, Savin- Burden, *Virtual Humans…*, XXXII.

relations have a universal character, are imprinted in man as a *secretly conceivable image*[9], and represent the two vital beginnings of man's actual existence[10].

The philosopher defined the world of *It* as the world of objectified knowledge and human experience, as the world of becoming (*objective being*[11]). *Thou* are the world of living action and perception, the world of freedom, creativity, belonging to the spirit. However, per its dual essence, *Thou* are *doomed to become a thing*. In the world of the *I-Thou* relationship, not only the *It-world* but the *I* is born and develops. Through a complex relationship with *Thou*, the *I* as something separate and distinct emerges. Martin Buber describes this process in amazingly poetic language:

> "Man becomes a I through a You. What confronts us comes and vanishes, relational events take shape and scatter, and through these changes crystallizes, more and more each time, the consciousness of the constant partner, the I-consciousness. To be sure, for a long time it appears only woven into the relation to a You, discernible as that which reaches for but is not a You; but it comes closer and closer to the bursting point until one day the bonds are broken and the I confront its detached self for a moment like a You-and then it takes possession of itself and henceforth enters into relations in full consciousness"[12].

By acquiring ontological status, the concept of *I* defines for each thing a place, a conditionality, an organization in space and time, and includes things in the chain of causation. Only *Thou* emerges from this chain of causality as the acting and giving agent. Buber called this relationship the *fundamental truth of human existence*: only *It* can be ordered. By ceasing to be *Thou* and becoming *It,* do things lend themselves to coordination. *Thou*, unlike *It*, knows no system of coordinates.

However, everything that has become *It*, *frozen* into a thing, continues to carry the meaning and purpose that *Thou* has invested in it. Therefore, everything existing objectively in the object world must, in time, be *revived* by the energy of personality, inflamed by the spirit of creativity and freedom, contemplated, perceived, and experienced by people as a present. However, Buber stressed, this plan is hindered by people petrified in the real, belonging to the It-world. Martin Buber did not deny the role of It in the development of humanity. He wrote: »without It, a human being cannot live. But whoever lives only with that is not human«[13].

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[9] Martin BUBER, *I and Thou. A new translation with a prologue »I and you« and notes by Wulter Kautvann,* NY, Charles Scribner's Sons, 1970, 53.

[10] Kramer P. KENNETH, *Martin Buber's I and Thou: practicing living dialogue. Kenneth Paul Kramer with Mechthild Gawlick*, New Jersey, Paulist Press, 2003, 18.

[11] Lubov E. MOTORINA, Veronica M. SYTNIK, Man's Attitude to Things: Objective Being, *Nova prisutnost*, 17 (2019) 1, 163-173.

[12] Buber, *I and Thou…*, 80.

[13] *Ibid*, 85.

As a methodological basis for studies of personal space, we can also consider the *typology of the I-Thou relation*, elaborated by Russian philosopher Semyon L. Frank in his famous work *The Unfathomable* (1939). Frank distinguished two *main types of the I-Thou relation*: the one of hostility, threat, a horror and the one of cordiality, warmth, partnership, the experience of unity.

Considering the first type of the *I-Thou* relation, when *Thou* is experienced as something alien, creepy, threatening, Frank explains these experiences by the fact that *Thou* lies on the same level as *I* and, in this sense, is similar and equal to it[14]. *Thou* as the *second Self* contradicts the singularity of the *I*, and therefore possesses all the eeriness of the »counterpart«. *Thou*, in this case, copies *I* as it were. In examining this type of relationship, Frank approaches the complex and understudied problem of the *boundaries of the self*. He writes that when the *I* encounter the *Thou*, it feels threatened, since through the *I-Thou* relation, it for the first time acquires authenticity, *recognizing boundaries* and therefore dangers. Frank observes that even outside the described relationship, the *I* have a boundary with the world of objects. Nevertheless, the objective being as something alien is on another level. The boundary is implemented differently there, as the objective being does not actively *invade the I*.

The second type of relationship is defined by the Russian scholar as one of cordiality, carrying the fullness of the unity experienced. *I* recognize itself in *Thou*, finds "a soothing, pleasing reality of similarity, a certain *homeland* of my own"[15]. In this case, encountering *Thou*, *I* is no longer aware of being alone, having met a being

> "filled with the element of my own inner being. It is a sensitive, understanding, penetrating inside Thou and *revealing I-Thou relation*, in which for the first time this relation is constituted in its full actuality"[16].

Frank's typology of the *I-Thou* relation is quite up to date. It explains to some extent the *uncanny valley (UVE) effect*[17]. Discovered by the Japanese roboticist and engineer Masahiro Mori back in 1978, which is that the more we make robots resembling people, the more (at the extremes of resemblance) people will experience a sharp rejection of the robots by the feel of terror. After the American scientist K. F. McDorman (Indiana University School of Computer Science, Computation and Engineering) published a translation of M. Mori's article from Japanese into English in 2005, and later in 2012, numerous studies of this phenomenon commenced in a variety of fields of knowledge. Similarity variables, hypotheses, methods, and graphs were modified, results and conclu-

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[14] Semyon L. FRANK, *Nepostizhimoe, [The Unfathomable], Sochinenia*, Moscow, Pravda, 1990, 363.

[15] *Ibid.*

[16] *Ibid.*

[17] Stephanie LAY et al., Circling Around the Uncanny Valley: Design Principles for Research into the Relation Between Human Likeness and Eeriness, *I-Perception*, 7 (2016) 6, 1-11.

sions were expanded, especially in psychology. Nevertheless, so far, scientists, regardless of the field of study, come to the same conclusion that the uncanny valley phenomenon (UVE) cannot be recognized as a scientifically proven, explainable, and repeatable fact[18]. We consider the nature of the *uncanny valley* phenomenon becoming clearer if we analyze the types of *I-Thou* relations considered by S. Frank as a methodological basis.

As some robot's resemblance to a real person grows, there comes the limit values of similarity parameters (researchers fix those at around 60-90 %), when a human no longer perceives the robot as an object being, which is less of a threat to it but perceives it as *Thou*, as the second *I* that has not yet become recognizable, but which can threaten the unity of *I*, its separateness. As it turns out, the robot is no longer an object for the individual but also not yet a subject (partner, assistant). The scenario develops according to the first type. The personality begins to perceive the robot as a being that is on its level, which contradicts the union of the I, and is therefore experienced with all the creepiness of the *double*. The uncanny valley effect (UVE) can be adequately investigated only following the methodology of the wholeness of Self. Quantitative indicators can assess only a projection of this wholeness, a moment, a tendency, a single parameter of similarity, but not the phenomenon as a whole.

The convergence and separation of Self and Thou reveal the contradictory nature of human existence as a social being. The openness and insularity of personal space are structurally constitutive traits that determine its integrity and separateness. Through the selective admission of other people to Self, personal space regulates the degree of individual freedom and the quality and quantity of relations between people.

2. *The concept of personal space and its boundaries*

The American anthropologist and cultural researcher Edward T. Hall was the first to introduce the concept of *personal space*. He described that as an invisible sphere (bubble) surrounding a person, having hidden borders and constantly accompanying an individual. Attempts to penetrate this space are perceived as an encroachment on personal freedom. The invisible boundary widens and narrows depending on many circumstances: relationships with other people, the emotional state of the individual, the cultural component, and the activity that occurs at the moment of communication[19]. Following E.

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[18] Karl F. MACDORMAN, Steven O. ENTEZARI, Individual differences predict sensitivity to the uncanny valley, *Interaction Studies*, 16 (2015) 141-172; Chin-Chang HO, Karl F. MacDORMAN, Measuring the Uncanny Valley Effect: Refinements to Indices for Perceived Humanness, Attractiveness, and Eeriness, *International Journal of Social Robotics*, 9 (2017) 1, 29-139.

[19] Edward T. HALL, *The Hidden Dimension*, Garden City, New York Doubleday, 1966, 101-111.

T. Hall's conception, it is possible to distinguish two constructive ideas with methodological significance. First, the idea of four distances of personal space (intimate, personal, social, and public), which the scholar described in the structure of interpersonal contacts[20]. Each distance, in turn, is represented by two phases – *close* and *far*. The admission of another person to each distance and phase is strictly selective. Second, the idea of the communicative context of culture. The scholar concluded that every culture has its communicative context, implicitly present as a hidden dimension. He created a classification of cultures, distinguishing them as having high and low communicative context, where individual distances of personal space and its other characteristics differ significantly.

Hall's ideas later became the focus of socio-philosophical, socio-psychological, methodological, anthropological, biological, and other studies. I. Altman, M. Chemers, and A. Vinsel further developed them in the concept of *privacy*[21]. Under privacy, the academics meant »selective control of access to Self«. They identified forms of human spatial behavior: *individual distance, personal space proper, territoriality, and personalization of the environment*. The allocated forms of the spatial behavior of the person can be united in two mutually supplementary groups.

The first group includes individual distance and personal space proper, and the second group includes territoriality and personalization of the environment. In the first case, a person provides direct protection of himself as a person by creating an *air bubble* around himself, trying always to be at some distance from other people. The territoriality and personalization of the environment represent an objectified, materialized individuality. Both are perceived as reliable boundaries and as a place with which the individual *identifies* themselves and feels safe.

Personal space, territoriality, and personalization of the environment are specific manifestations of the universal types of *I-Thou* and *I-It* relations highlighted by M. Buber and S. Frank. *Wearable* space in the form of an *air bubble* is a metaphor that refers to the living, developing interpersonal relations. Depending on the latter's content, a boundary is formed, dynamic, often unconscious, but experienced quite emotionally by the individual in the continuum of *in-group and out-group* meaning. In any case, this is a positive relationship through which the identity, originality, individuality, self-understanding, self-perception, and self-esteem of a person are formed. The personalization of the environment represents when the *Thou* is doomed to become a thing, to become frozen in the *It*. However, the personalization of the environment

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[20] *Ibid*, 113-125.
[21] Irwin ALTMAN, Martin M. CHEMERS. *Culture and environment*, Monterey, Calif., Brooks – Co1e, 1980, 337; Irwin ALTMAN, Annte M. VINSEL, Personal space. An analysis of E. T. Hall's proxemics framework, *Human behavior and environment: advances in theory and research*, 2, N. Y., Plenum, 1977, 181-259.

also implies the reverse process – the revitalization of *It*, its spiritualization, its return to culture.

The *I-Thou* relationship manifests the integrity of the vital existential practice of personality as the original and most authentic foundation of human existence. The *personal dimension and integrity* are *constitutive* of personal space. Existential practice, in turn, is the unity of *existential experience* and *existential project*[22] since human existence is always projective. Personal space is that in which different worlds intersect – the natural world (the first nature), the artificial world of culture (the second nature), the world of information technology (extended reality). Hence the multivariant determination of personal space: biological, psychophysiological, socio-cultural, technological. Their intertwining, conflict, competition, adaptation, boundaries, and coherence largely determine the personality's attitude to themselves, their self-determination.

The so-called hidden dimensions play a unique role in the structuring and functioning of personal space. The founder of proxemics, E. T. Hall, emphasizes the importance of those in the title of his 1966 seminal work, *The Hidden Dimension*. Another English scholar M. Polanyi almost at the same time, wrote about the phenomenon of tacit knowledge as a phenomenon of *personal knowledge*. The main provisions of the concept he developed when artificial intelligence was of great interest to scientists. M. Polanyi, from the very beginning, was critical of the idea of the similarity of mechanical models of thinking with human thought processes. Discussing artificial intelligence with his colleagues, he tried to substantiate the thesis that any knowledge has an essential element of understanding, which, in his opinion, is inherent exclusively to human thinking and which he defined as implicit, tacit knowledge[23]. He concluded that each member of the scientific community should have a personal space to spontaneously search for a solution to a problem, determined by his intellectual passions.

German cognitive scientist Frank Hegel, studying the role of hidden dimensions of people's perception of each other in interpersonal contacts, notes that when we meet a person for the first time, we almost automatically rely on visual and other cues (hidden dimensions) indicating belonging to a particular social group. Referring to extensive socio-psychological research[24], Hegel notes that

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[22] Lubov E. MOTORINA, Veronica M. SYTNIK, Existential, Instrumental, and Cyber Spaces as Ontological Modi of Human Being, *Nova prisutnost*, 17 (2020) 3, 485-498.

[23] Michael POLANYI, *Personal knowledge*, Chicago, University of Chicago Press, 1958, 428.

[24] Susan T. FISKE, Stereotyping, prejudice, and discrimination, *Handbook of Social Psychology*, New York, McGraw-Hill, 1998, 357-411; Patricia G. DEVIN, Stereotypes and prejudice: Their automatic and controlled components, *Journal of Personality and Social Psychology*, 56 (1989) 5-18; John A. BARGH, The cognitive monster: The case against controllability of automatic stereotype effects, *Dual process theories in social psychology*, New York, Guilford, 1999, 361-382; John A. BARGH, *Before You Know It: The Unconscious Reasons We Do What We Do*, New York, Touchstone, 2017, 319.

our instantly formed judgments rely on so-called activated tacit knowledge structures that people intuitively understand.

American neurophysiologist David H. Hubel and Swedish neurobiologist Torsten Wiesel (1981 Nobel Prize in Physiology or Medicine) showed that the artificial neural network contains no hidden layers, which imposes a limit on its effectiveness. Hubel and Wiesel demonstrated the *architecture of a natural solution* to the neural networks' use of hidden levels. Hidden levels in personal space architecture provide its integrity, uniqueness, and protection.

Thus, personal space is a holistic, complexly structured phenomenon of I as a personal dimension of human existence in its unified and singular statuses. The content of personal space is existential experience and existential project as a person's sense-life and value orientations in actual and potential modes. The term »space« in combination with the term »personal« implicates the boundaries between the personal and the impersonal, between I-Thou and I-It relations, between the physical world and the extended reality (XR). The introduction of the concept of personal space as a methodological tool allows us to analyze various aspects of its changes that arise in the technological context.

3. Transformation of personal space in the development of information technologies and social robotics

Considering the technological context of personal space's existence, the changes that inevitably occur to it under new conditions, we want to highlight three key moments, important from the methodological point of view. First, the *I-Thou* relation is fundamentally changing, the sphere of direct contacts is narrowing, and the number of *mediated relations* is growing with geometric progression. In this sense, we can talk about the formation of a particular space of communication, the so-called *cultural interfaces*[25] designed to mitigate the contradiction between the technological, socio-cultural, and biological determinants of human interactions with another person and various environments. *Cultural interfaces* are created as a compromise between the worlds of *I-Thou* and *It*. The purpose of their creation, covering all the diverse forms of life activity, is to adapt the limitless possibilities of information technology development to the limited capabilities of human beings. As relations between people are mediated by a multitude of interfaces, from ordinary computer applications, author and personal interfaces to modular interfaces of social robots[26],

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[25] D. V. GALKIN, Osnovaniia sotsial'noi robototekhniki v kontekste sotsial'no-gumanitarnykh issledovanii [Foundations of Social Robotics in the Context of Socio-Humanitarian Studies], *Vestnik Omskogo universiteta*, 2 (2014) 167-177, 169.

[26] Frank HEGEL, A Modular Interface Design to Indicate a Robot's Social Capabilities, *The Sixth International Conference on Advances in Computer-Human Interactions*, Nice, 2013, 426-432.

the *I-Thou* relation morphs into the *I-It-Thou* one, which invariably limits the existential experience of the individual, reduces trust, empathy, emotional experience, and other qualities of interpersonal contacts. The mechanisms of personal space, that is, being open to some and closed to others, mediate the options of access and blocking; or, on the contrary, a smart interface guides a person's actions, replacing free personal choice.

Secondly, personal space as an integral phenomenon of *I* in information technology development creates a lot of functional personal profiles in various artificial realities, thereby as if distributing itself between them. The *problem of preserving the integrity* of personal space and its protection arises. This issue not only remains unexplored so far but has also not yet been properly stated. The existing studies in various fields of knowledge reveal only fragments, projections of personal space. If we proceed from the principle of integrity, then the basis for the unity of multiple profiles should be associated with the reality with which a person identifies himself or herself. Separate personalization processes in different computer environments remain involved in integrity. They are drawn to that primary reality in which the personality is born, socialized, acquires the status of personal space of the unified phenomenon of *I*.

Finally, the third point has to do with the entry of personal space into close interactions with both service and physical robots[27]. The development of social robotics has fostered cooperation between various disciplines, such as philosophy, psychology, linguistics, sociology, ethology, neuroscience, ethics, and others. These interdisciplinary studies have provided the experimental scientific foundation for a relatively new field of knowledge known as human-robot interaction (HRI)[28]. Initially, the attention of researchers in this new field of knowledge was focused on identifying the *similarity parameters* of both the external design (body) of the robot and the "personality" traits as analogs of human abilities. However, the focus has gradually shifted to human-robot *interaction* as an essential element of the new HRI system. To increase the efficiency of human-robot interaction, there was a change in the *strategy* of developing robots capable of acting in *personally meaningful* relationships with a wide variety of age and social groups[29]. The new strategy required the programming of new properties: the robot's ability to give an impression of responsive-

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[27] The author of the article comprehends the robot as an embodied and socially functioning artificial intelligence.

[28] Kerstin DAUTENHAHN, Special Issue on »Human and Robot Interactive Communication«, *Interaction Studies*, 9 (2008) 2, 175-178; Daniel CONTI et al., A cross-cultural study of acceptance and use of robotics by future psychology practitioners, *24th IEEE International Symposium on Robot and Human Interactive Communication*, Kobe, 2015, 555-560.

[29] Guy HOFFMAN et al., Robot Responsiveness to Human Disclosure Affects Social Impression and Appeal, *9th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, 2014, 1-8; Anne BLOEM et al., Improving Emotional Expression Recognition of Robots Using Regions of Interest from Human Data, *Conference: HRI '20: ACM/IEEE International Conference on Human-Robot Interaction*, Cambridge, 2020, 142-144.

ness, to interact with people during a conversation successfully, to use human understanding mechanisms such as speech, visual cues (especially facial information), and others. In all functional roles, the robot is required to be "psychologically sensitive" to its partner and to behave in accordance with its needs. In such scenarios, how a robot responds to human communication can have a profound effect on a range of personal and interpersonal interaction outcomes, including human perception of the robot, human-robot relationship, human mental health, human willingness to continue to trust the robot, and overall human well-being. The latest wave of research is related to the development of social robots that take *maximum account of the personality factor*, i.e., adapted not just to personally meaningful relationships but to the specific features of a particular individual[30]. These studies are undoubtedly of interest to developers of socially assistive robots-partners in education, upbringing, health care, and caring for sick and elderly people. The personal dimension of human-robot interaction as an imitation of interpersonal contacts brings it to a new level, when a human can perceive a robot as a helper, partner, i.e., as a being that makes life more comfortable and qualitative. The development of this kind of relationship is facilitated by studies of *psychometric indicators* of how well the robot can match the mental and existential expectations of the person entering the relationship[31]. The *I-It* morphs into a new type of *I-Thou-It* relationship, which can be considered a dominant component of the technological context.

Conclusion

The development of the technological context as the semantic basis of information technology and social robotics presupposes the development of a convergent approach to interdisciplinary problems, the development of a conceptual and categorical apparatus that helps to bridge the gap between technological and humanitarian-scientific knowledge. The expansion of the continuum of realities actualizes the problem of the personal dimension of human existence. The article reveals the methodological foundations of the study of personal space: the principle of unity, the principle of the duality of the nature of being, the typology of the I-Thou and I-It relationship. The author's definition of personal space as an integral phenomenon of the Self is proposed as a methodological tool for studying its transformations. The article identifies the problematic points of changing personal space in the technological context:

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[30] Juan MARTINEZ-MIRANDA et al., Age-based differences in preferences and affective reactions towards a robot's personality during interaction, *Computers in Human Behavior*, 84 (2018) 245-257; Ali MEGHDARIL et al., Arash: A social robot buddy to support children with cancer in a hospital environment, *Engineering in Medicine*, 6 (232) (2018) 605-618.

[31] Chrishiian U. KRAGELOH et al., Questionnaires to Measure Acceptability of Social Robots: A Critical Review, *Robotics*, 8 (88) (2019) 3-14.

the mediation of personal contacts by interfaces; the contradiction between the integral phenomenon of the Self and a set of personal profiles in an interactive computer environment; the entry of a person into a new type of human-robot relationship (HRI); changing the HRI research strategy towards personally meaningful relationships; the acquisition of a new existential experience by a person. Modern ways of changing personal space are not just a matter of understanding the space, but also the question of its participants, that is, new beings who appear in it, such as new virtual people, social robots, with which a person is called to cooperate, that is, to establish a certain human-technological relationship. The dominant component of the technological context is the objects in which the humanely is intertwined with the technological. The boundaries between the natural physical world and augmented reality (XR) are blurring. All this leads the author to the conclusion about the emergence of a new hybrid reality, which in the future can be called third nature.

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Osobni prostor i njegove transformacije u tehnološkom kontekstu

Sažetak

Kontekst i važnost istraživanja: Stvaranje autonomnih računalnih agenata i humanoidnih robota postaje prioritetna tema istraživanja u raznim poljima znanja. Jaz između tehnološkog i humanitarnog diskursa pokazuje potrebu za dijalogom i razvojem zajedničkog pojmovno-kategorijskog sustava u informacijskoj tehnologiji i humanitarnom znanju. Širenje kontinuuma umjetne stvarnosti aktualizira antropološke probleme, uključujući pitanje novog ontološkog statusa osobe, osobnog prostora, unutar kojeg svi aspekti i projekcije ljudskog postojanja prolaze kroz značajne promjene. Osobni prostor kao ontološki fenomen sebstva komunicira s različitim okruženjima (priroda, društvo, kultura, proširena stvarnost [*extended reality* – XR]), ima granice s njima i djelomično funkcionira u svakoj. *Svrha studije*: razviti metodološku osnovu za proučavanje osobnog prostora, formulirati autorovu definiciju osobnog prostora i identificirati konceptualne metodološke konstrukcije za analizu transformacije osobnog prostora u razvoju informacijske tehnologije i socijalne robotike. *Upotrijebljena metodologija*: načelo integriteta, načelo dualnosti bića, tipologija odnosa (M. Buber, S. Frank), sistemska analiza, konvergentni pristup. *Glavni zaključci*: Razvoj informacijske tehnologije i socijalne robotike otvorio je novu fazu u formiranju tehnološkog konteksta ulaska čovjeka u simbiotske odnose, gdje su granice između prirodnog i umjetnog nejasne, što ukazuje na potrebu za razvojem konvergentnog pristupa proučavanju interdisciplinarnih problema tehnološkog i humanitarnog znanja. Autorska definicija osobnog prostora kao integralnog fenomena sebstva predlaže se kao metodološki alat za proučavanje njegovih promjena u tehnološkom kontekstu.

Ključne riječi: autonomni računalni agent, egzistencijalno iskustvo, interakcija čovjek-robot (*human-robot interaction* – HRI), osobni prostor, socijalni robot, tehnološki kontekst, transformacija osobnog prostora.

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