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Anthropologically oriented strategies of interaction in the Human-Computer system

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Anthropologically oriented strategies of interaction in the Human-Computer system

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Abstract. The article, based on the application of anthropological methodology, reveals the phenomenology of the physical-mental interaction between a person and a computer. Ways of integrative use of the concept of Umwelt by J. J. von Uexküll and the theory of movements construction are represented, and Umwelt-oriented strategies for improving computer technologies are presented. The Umwelt, as the world of perception and the world of human activity (in particular, cognitive), can be represented as an anthropo-computer world. On the basis of the current features of the body-mental Umwelt, ways of anthropologically directed improvement of HCI are determined. Using the questionnaire developed by the authors and applying cluster analysis, a survey of students of higher education institutions was conducted in order to determine the physical and mental orientation in Umwelt oriented interaction in the human-computer system. The interpretation of the research results indirectly indicates the systematicity, equality of interaction in the human-computer system. This determines the possibility of distinguishing typical ways of interaction in the human-computer system, among which the bodily and mental-psychological ones are significant, which correspond to certain levels that characterize the systemic, spatio-temporal and structural-functional organization of motor activity in the theory of movements construction.

1. Introduction

The problem of human-computer interaction is relatively traditional and established. This permanently relevant problem is presented as a through-and-through and constant, first of all, in connection with the co-evolutionary (for now) development of information technologies and, so far, the relative transformation of the person himself and his adaptation to the "Digital World". Accordingly, consideration of the specified problem in the direction of both sociocultural and technical-technological understanding is significant, systematic and multidimensional, which includes an anthropologically oriented interpretation of it. This is due, first of all, to the global trend of digitization of both technology, education and science, as well as socio-cultural and industrial spheres in general, as well as trends in the humanization and greening of earthly civilization. This is also determined both by requests aimed at constant technical, software and intellectual improvement of the digital sphere, and by issues of effective use of computer technology, which in turn are determined by the specifics of interaction in the human-computer system. Currently, there is a significant variety of ideas, visions, approaches and models presented in the scientific literature, which reveal the specifics of interaction in the human-computer system, both in specific technological and problem-oriented issues, and at the level of theoretical reflections and futuristic forecasts.

Interesting in this direction are the studies of recent years, which we will briefly present (figure 1, figure 2, figure 3).

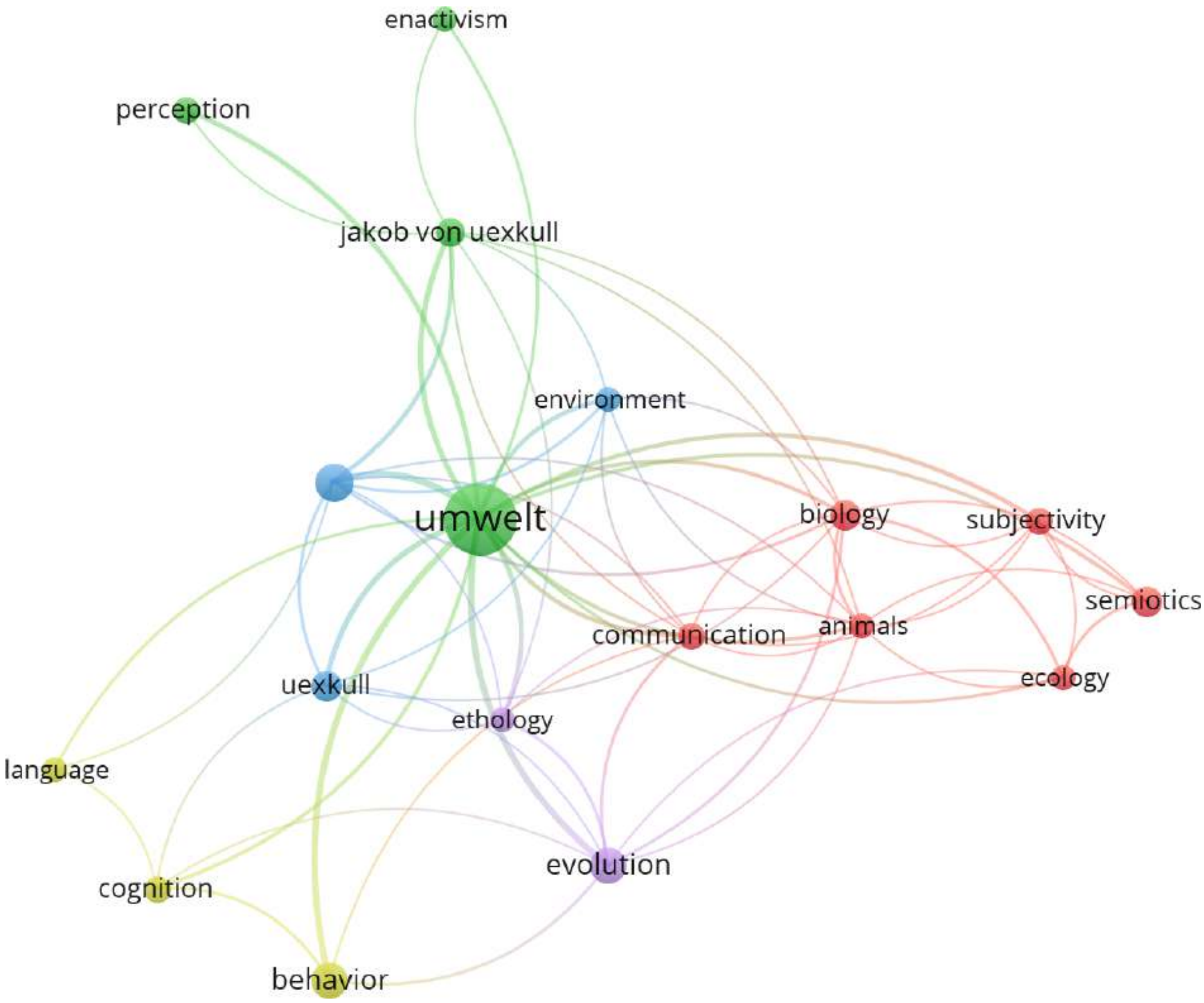

Figure 1. Connection map of thematic categories of research by scientists for five years (2018-2022) related to the topic "Umwelt", which are placed in the database of the multidisciplinary scientific platform Web of Science [1, 2].

In the study by Saeed et al. [4], having conducted an analysis of articles from 2017 to 2022 devoted to the problem of using gestures for human-computer interaction (HCI) using Sensory Gloves, comes to the conclusion that one of the directions for solving this problem is the improvement of the relevant deep learning algorithms and the decision to reduce the size of the equipment for greater compatibility and mobility of the system, as well as the search for compromises between robustness and sensitivity of the system. The system-organizing factor in this study was the dominance of technical solutions over anthropological solutions.

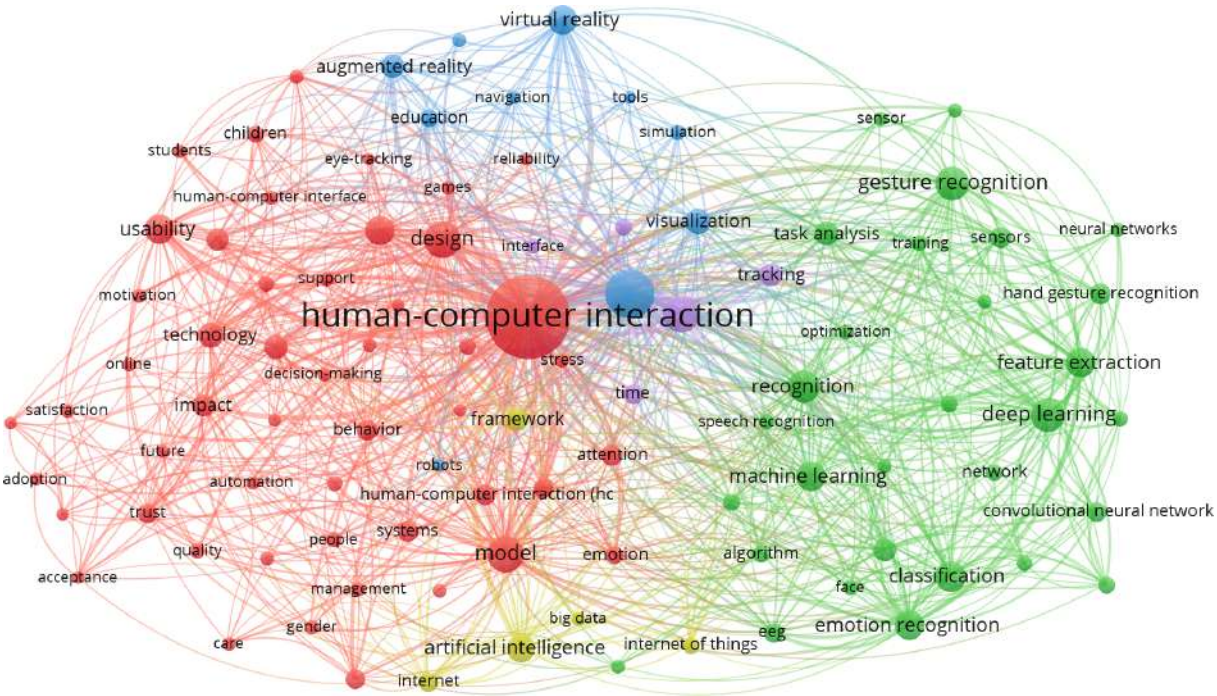

Figure 2. Connection map of thematic categories of research by scientists for five years (2018-2022) related to the topic human-computer interaction, which are placed in the database of the multidisciplinary scientific platform Web of Science [1, 2].

The analysis of the user experience in the design of the interface of human interaction with the computer was investigated by Xiong and Hou [5]. To create a more personalized interface design in order to meet the needs of the user, they used an optimized Kalman filter, which provides higher speed and accuracy of recognition of the gesture function [5].

Burrows et al. consider the issue of a mental model of HCI based on deep learning using convolutional neural networks and generative adversarial networks, offer solutions for solving the problems of stress and negative mood detection, defining strategies to counteract these negative phenomena [6]. The authors update attention to the problems of emotional intelligence, real-time design of HCI.

Sun et al. [7] made a "dispersion theory-based redundant electrode detection method" to optimize thumb motion-based gesture recognition using sEMG signals, thus addressing a specific "bodily-motor-mental-technical" a problem aimed at optimizing and increasing the efficiency of HCI.

Yun et al. [8] develops the problem of decision-making using visual HCI. The architecture of the visual decision-making system is developed on the basis of intelligent data analysis. In this way, the spatial-visual-intellectual dimension of the problems of interaction in the human-computer system is practically revealed.

Tarasenko et al. [9] consider the phenomenon of HCI in a practical way with the aim of improving simultaneous translation skills.

Robinson et al. [10] conducted a comprehensive analysis of articles on robotic vision over the past 10 years. According to the results of the study, it was found that the issues of robotic vision for recognizing actions, gestures and moving them in the space of human movement, as well as for ensuring interaction between a robot and a person, demonstration of actions to a person, training and social communication [10] were most often investigated.

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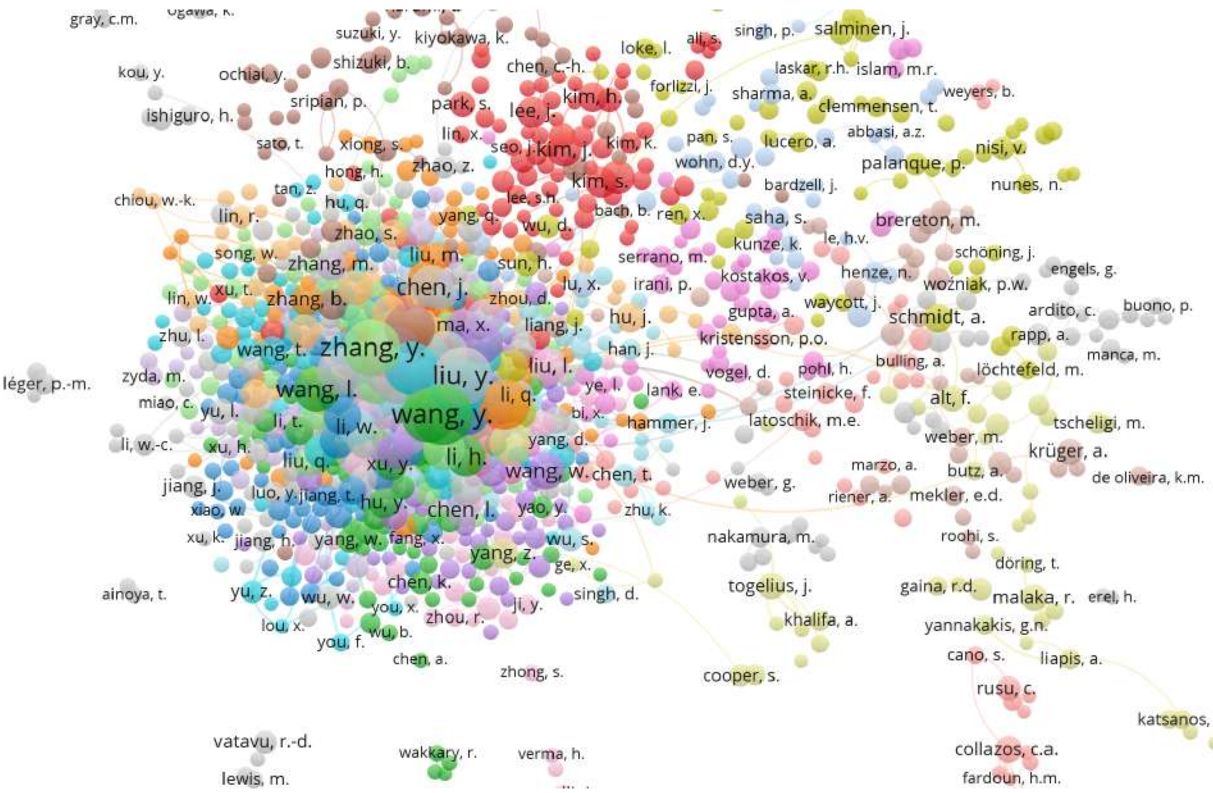

Figure 3. Connection map, created on the basis of the data of joint citations of authors in the field of human-computer interaction for five years (2018-2022), whose scientific works are placed in the abstract and citation database Scopus [2, 3].

The scientific interests of researchers are increasingly correlated with issues of health problems related, in particular, to the mental state of a person in the process of HCI, the emergence of computer addiction [11, 12].

The use of immersive technologies in e-learning, in particular game technologies based on virtual/augmented reality, are important issues of HCI research [13–19]. The results of many studies have shown that the balanced and appropriate use of these technologies in e-learning provides an opportunity to increase the educational achievements of students.

The growing role of the use of computer systems for health preservation, monitoring systems of the state of the surrounding environment actualizes the issue of digital literacy for effective and adequate use of providing HCI [20, 21]. Research by scientists shows that the issue of digital literacy of users of technological services in the health care system is a key component of their use.

At the same time, despite a significant amount of work in this direction, the insufficiently disclosed anthropocultural and psychological aspects of the problem, namely the correlation and correspondence of computer tools (technical, software, etc.) to the nature of man and his culture, are significant. In clarification, let's point out some significant specific issues of interaction in the human-computer system. These include human-oriented and interdependent issues of existence, integrity, harmony, corporeality, emotionality, formation of meanings, conjunctiveness, corporeal mind, sensory and motor interaction, etc. [22]. Summarizing, we can say that a person, due to his "anthropo-bio-psycho-cognito-socio-cultural" nature, needs a systemic, multidimensional and multichannel (polyfunctional) and human-dimensional interaction with the computer, which is implemented through a special "contact" interaction environment. That is, the currently dominant semiotic-symbolic, digital screen and partly figurative-semantic interaction needs a certain expansion and addition. This includes the imitation of human existence, presented in the format of Lebenswelt (Life World according to E. Husserl) [23]. Methodologically significant in this direction can be the application of concepts that holistically, systematically, autopoietically and in relationship and through the meanings of harmony with the environment reveal the "body-cognitive" nature of a person, namely: the embodied mind J. Lakoff [24, 25], enactivism, biomechanics – in particular, theories of movements construction [26], functional systems (physiological theory), Umwelt [27,28], functional circle (German: Funktionskreis) [28], concept of autopoiesis by H. Maturana and F. Varela [29] and others.

Human nature is characterized by "expansion", knowledge and expansion directed both outward into the "visible" world – the Macrocosm (Greek: $M\alpha\kappa\rho o\kappa o\sigma\mu o\zeta$), and immersed in its own special world – the Microcosm (Greek: $M\iota\kappa\rho o\kappa o\sigma\mu o\zeta$), through self-knowledge. According to the peculiarities of biological and mental human nature, within which the "expansion" of a certain part of both the environment and the inner world is relevant, it is the "creation" and existence of a person in the special realities generated by it – social, cultural, digital, mental-psychic. In the anthropocentric understanding and solution of the problem, a person, according to his essence, aims to "include" the computer in his anthropic world and transform it into an acceptable, understandable, predictable phenomenon – an object, a semiotic system or a part of this world. Another (unacceptable and opposite) to the indicated human-centric technocentric way of interaction in the human-computer system is also possible, in the implementation of which a person will be included in the world of the computer, adapting to it.

Summarizing the above, we actualize the need for anthropologically oriented studies of the problems of human-computer interaction, first of all, from the standpoint of systems theory. This approach is based on the integration of: human psychology, ergonomics, the need for multi-channel interaction; human morphophysiology (structure and function); bodies and physicality (social and psychological representation of the body); specifics of motor activity; speech; general and specific features of activity. We use the concepts of Umwelt as a methodological way to a multi-faceted systemic and holistic description of interaction in the human-computer system.

So, guided by the ideas of systematicity, integrity, expansive character and multidimensionality of the nature of the living and, above all, spiritual-mental, epistemological and activity-praxic and sensory-motor entities of man, we actualize the idea of considering the interaction in the human-computer system on based on the application of the Umwelt concept of the human cognitive and activity world [15]. Unlike other living organisms, the Umwelt of a person is presented as multidimensional and one in which intellectual and semiotic-symbolic aspects are decisive. The idea of Umwelt is interesting primarily because it represents a living organism not only and not so much as an isolated object, but as a systemic, multifunctional, multifaceted interaction of man and the environment, or, more precisely, as a special world that is formed by interaction with the environment, the Umwelt concept also effectively, systematically and variably reflects the phenomenon of the boundary-contact between a person and the environment, which is emphasized in Gestalt psychology. In the idea of Umwelt, as well as in the concept of the boundary-contact, the diversity and specificity of the cognitive and active nature of a person is manifested in the context of considering it in temporal and spatial aspects. To analyze the interaction in the human-computer system, we suggest using another component – the Human Umwelt. Then the human-computer system will be represented in an extended, complementary and variable manner as "Human – Human Umwelt – Computer". Human Umwelt in the specified system is considered at the same time: as a method of description and interpretation of interaction, as a boundary-contact determining the limits, dimensions and intensity of interaction, as a semantic-meaning field of sensory-motor-cognitive-activity interaction. As a model of Umwelt, which systematically and holistically represents human nature, we propose to consider the theory of movements construction. The specified theory describes the nature of motor activity taking into account the sensory-analytical, existential and spatial components, and also reveals the nature of cognitive and object-activity transformation of motor activity. Man, as a "bodily-motor-mental" being, within the framework of this theory, is consistently, integratively and systematically represented as vital-existential-sensual-motor, as bodily-synergistic-motor, as motor-spatial-cognitive, as object-activity-cognitive, as a physical-speech-intellectual and as an intellectual-spiritual phenomenon.

In the scientific literature, the problem of HCI in the context of the actualization of the phenomenology of the human Umwelt and its purposeful application for the development of software and computer equipment is not disclosed. This study is relevant to the current socio-cultural and scientific-practical trend of NBIC convergence. Accordingly, taking into account the significance of the indicated direction of research for humanizing and anthropologizing interaction in the human-computer system and further anthropocentric, ecocentric and "biocentric" directions of development of computer technologies, including robotics, virtual/augmented reality, development of smart environments (educational environments, smart houses, smart cities, etc.), we present this research as relevant.

Purpose. To conceptualize anthropologically oriented strategies of interaction in the human-computer system based on considering it as a spatial sensory-activity-cognitive reality.

2. Selection of methods and diagnostics

The research used a system of methods and approaches: systemic, ontological; hermeneutic; phenomenological [23]; biosemiotic (R. Millikan [30]); anthropological; cluster analysis. Methodical approaches developed in the system of digital anthropology, embodied cognitive science (L. Shapiro) [31], enactivism (F. J. Varela, E. Thompson, E. Rosch [31,32], biomechanics [15, 26], pedagogy [13–15] were applied.

Theories and concepts were applied: Umwelt (J. J. von Uexküll, [27,28]; of a functional circle (German: Funktionskreis) (the concept of J. J. von Uexküll) [27, 28]; the life world (German: Lebenswelt) of E. Husserl [23]; autopoiesis (H. Maturana and F. Varela) [29]; embodied mind J. Lakoff [24, 25]; muscle clamps and "character armor" [33] rhizomes (according to J. Deleuze and F. Guattari) [34]; archetypes and the collective unconscious of C. Jung [35,36]; the boundary-contact developed in Gestalt psychology [37, 38], the psychological field of K. Levin, functional systems. The applied ancient Greek concepts of Kairos (Greek: $K\alpha\iota\rho$oζ), Chronos (Greek: $X\rho$oνoζ).

Own methodological developments. In the study, the "Fedorets-Klochko Questionnaire was used to determine the body-mental orientation in the Umwelt oriented interaction in the human-computer system". The purpose of using the specified questionnaire was the primary diagnosis of interaction in the human-computer system is presented in the format of a physical-mental-spatial phenomenon – *anthropo-computer Umwelt.* The specified interaction was considered as a manifestation of the human Umwelt, which covers both sensory-cognitive and sensory-perceptive as well as mental and activity dimensions of the human.

Fedorets-Klochko Questionnaire was used to determine the body-mental orientation in the Umwelt oriented interaction in the human-computer system

1. Are you comfortable in the environment where the computer is located?
2. Do you have unpleasant physical and mental sensations when you are near a computer?
3. Do you feel fear, dislike, discomfort if there is a computer nearby?
4. Do you have positive physical and mental sensations when you are near a computer?
5. Are you interested in looking for and viewing on the computer screen the images of the elements and the world's primordial foundations, for example, fire, water, sky, sun, stars, outer space?

6. Is it interesting and important for you to perform similar and repetitive actions while working at the computer, for example, frequently checking mail, visiting familiar sites without special need?
7. Do you often listen to music while working at the computer?
8. Are you interested in working on a computer/tablet/smartphone on the road while walking or while waiting?
9. Do you often feel a sense of rhythm, peace and harmony while working at the computer?
10. Are you interested in looking at pictures of nature or natural artifacts, for example, trees, stones, animals, insects, etc. while working at the computer?
11. How often or systematically do you observe pictures of nature as landscapes and isolated artifacts of the process of working at the computer?
12. Do you often have a desire to immerse yourself in fantastic worlds and corresponding spaces created with the help of computer graphics?
13. Are you interested in artistic paintings, films and games where there are images of landscapes and earthly spaces, for example, the sea, forest, mountains, steppe, etc., while working at the computer?
14. When working at the computer, are you interested in graphic images, movies, and games in which movement in space is available?
15. Are you interested in images, movies and games that contain images of architectural buildings and cities while working at the computer?
16. Are you interested in observing the work of people and mechanisms/machines while working at the computer?
17. Are you interested in finding and looking at different interiors and things created by man while working at the computer?
18. Are you interested in images, movies and virtual games that contain images of architectural buildings/cities when working at the computer?
19. Does working at the computer help reveal your intellectual potential?
20. Does working at the computer contribute to the disclosure of your spiritual, mental and emotional potential?
21. Does working at the computer increase your interest in certain professional and life spheres?
22. Have you become smarter as a result of working at the computer?

Variants of answers: "No", "Can't decide", "Yes, to a small extent", "Yes", "Yes, to a large extent".

Let's consider the conceptual and semantic bases of the questionnaire. The understanding of "Umwelt-interaction" in the system "Human-Umwelt-Computer" is based on the theory of movements construction. The system-organizing methodological factor that determines the application of the specified theory is the systemic, multidimensional, holistic and "anthropic" nature of motor activity, which reflects the nature of man as a sensory-perceptive, active, and mental being and as a "motor-activity-mental" way of interacting with the environment. In the content-semantic framework of the theory of movements construction, motor activity is considered multidimensionally as: existential-bodily, sensory-perceptual, sensory-motor, spatial-motor, activity-praxis (working with objects and tools), body-motor-mental, speech-mental and mental phenomena. The phenomenology of the motor sphere presented in the theory of movements construction reveals the essence of man and his interaction with the environment as a special harmonized motor-praxical-mental world. Accordingly, a person and his "world of interaction" with the environment is represented in sensory-perceptual, spatial-temporal, activity-motor (praxis), activity-cognitive, speech-mental formats. It is methodologically significant that a person's perception and cognition of the world and its activities are considered as defining aspects of the Umwelt. To clarify, we note that the Umwelt is a sensory-perceptual-cognitive-active world. According to J. J. von Uexküll [27, 28], the Umwelt is the world of Perception and the world of action.

It is decisive that the nature of a person, which is revealed through interaction with the environment, manifests itself in praxis (the ability to work with objects and tools is inherent only to a person) and in speech, communication and intellectual activity. The theory of movements construction are represented systematically, interdependently, multidimensionally, holistically, intentionally, which can be represented as special "worlds of interaction" (the world of Perception and the world of Action) – Umwelt. Thus, according to the ideas about a person as a multidimensional being – "existential-bodily-motor-spatial-praxis-speech-mental" and on the basis of understanding the peculiarities of his motor and mental and praxis-activity spheres, the questions of the questionnaire were formed. The group of questionnaire questions reflects the interaction of the corresponding level, which in the theory of movements construction has a certain degree of autonomy and systematicity and represents a "part" of the human Umwelt as a "perceptual-motor-active-mental" world.

The theory of movements construction presents motor activity, praxis (work with objects and tools) and speech-intellectual activity as a system in which 5 levels are distinguished (A, B, C, D, E). Each of the 5 levels is part of the following, although there is also a certain autonomy. Let's present the questions of the questionnaire in accordance with their certain levels. It is clear that it is not possible in a "pure" form or separately, by considering certain questions of the questionnaire, to reflect and characterize the state of each of the levels due to their interdependence and interpenetration. Questionnaire questions represent a mental-speech projection of a certain level of motor activity, perception, praxis and intellectual activity in the context of probable interaction with a computer.

The level of tonic movements (level "A") is revealed in the first 5 questions of the questionnaire (from the 1st to the 5th question). In the specified questions, the problem of sensory-perceptual and vital phenomenology of a person is actualized as a determining factor, which is revealed and interpreted in polar questions. In the questions of the questionnaire, the polar questions of comfort/discomfort, fear/absence of fear, pleasant/unpleasant sensations are actualized. But, first of all, the issues of positive sensations, sensory and perceptual images and reflections and their interpretations are considered as reflecting the state of this level "A". The cognitive aspect of the specified level is revealed through the actualization of the images of the elements and the world's primordial foundations – fire, water (sea, ocean, etc.), stones of the sky, sun, stars, outer space, etc. The questions conceptualize the problems of "simple" and not sufficiently differentiated sensations and sensory and perceptual images, which can be perceived, interpreted and represented as acceptable for the individual as well as antagonistic or polar. Such sensory, perceptual and partially emotional phenomena are simply presented as "positive" ("+") or "negative" ('–"). In the specified sensory and perceptual phenomena and partially in the emotional sphere, the primary biological and vital meanings associated with the basic existential and vital directions of a person are manifested. Emotions that can be manifested at the same time are close to thalamic ones. Such thalamic emotions, when considered in an evolutionary aspect, are ancient and close to pathological. They are undifferentiated and do not have a certain specific modality (visual, auditory, etc.) and primarily signal to the organism about two aspects of its existence – "good"/"safe" ("+") and "not good"/"dangerous" (bad "–") In the indicated sensory, perceptual and emotional phenomena, human vitality is reflected, as well as "sensory-perceptual" and "sensory-motor" ways of understanding or, more precisely, awareness of one's existence, which manifests itself as givenness and presence, which is expressed succinctly as "I" and "am".

In the questions of the questionnaire from the 6th to the 9th, the level “B” – “Synergistic movements” is reflected. This level in the context of HCI is interpreted somewhat more broadly, namely in the form of synergistic actions. To clarify, let’s point out that the action has a relatively complex algorithm, often stages, sequence and a certain purpose and meaning, while the synergistic movements is quite simple, rhythmic in its biomechanical implementation. Thus, through the levels “B” and “A”, the phenomenology of the rhythm that permeates the entire cosmos and manifests itself in human nature is manifested. Accordingly, rhythm is manifested in human temporality and is reflected in synergies, that is, in repetitive, rhythmic, oscillating, balancing movements. This level reveals the phenomenology of body space and the space near the body, the limits of which are the dimensions of the limbs and the body itself. Essentially, the contact between the body and the computer is within these dynamic limits. An imaginary zone in space that corresponds to this level “B” can be outlined as a sphere or an egg, where the boundaries are defined by limbs describing arc movements. Repetitiveness and rhythmicity of this level, which reflect the deeper rhythms of both the body and the cosmos and are manifested in the harmony of sounds – music and dance. Thus, the problems of repetition, rhythm, musicality, harmonization with oneself and with the world are embedded in the question of this level. Accordingly, in the system of this level, the computer and work on it can be considered in the semantic framework of promoting the manifestation of rhythm, harmony, as well as revealing the musical and poetic aspects of human nature. In this case, there will be a synergistic, complementary interaction, which should not only include synergistic effects, but be formed on the basis of them and thanks to them. Man in his biomechanical essence and by his human nature is harmonious. One of the ways of harmonization is the rhythm that manifests itself in the synergy of both movements and actions and interactions. It is also possible to have a polar or opposite interaction, which will manifest itself as ignoring rhythm and harmony.

Six questions from the 10th to the 15th reflect the level “C” – “Spatial movements”. The indicated level “C” manifests itself in a person through the implementation, first of all, of movements in space – walking, running, jumping. Thanks to this level, the spatiality and visuality of a person is revealed and formed. Space and movement in it reveal and form the corresponding sensory, perceptive and cognitive spheres in a person (for example, spatial perception, thinking, imagination, etc.). Therefore, the questions of the questionnaire concern the actualization of landscapes and landscapes, which are considered as real natural and anthropogenic, as well as “constructed” in the imagination of the artist, or virtual spatial phenomena. Also important are natural and anthropogenic spatial artifacts – stones, trees, animals, houses, objects, etc., which are represented both separately and as included in a certain spatial system – city, forest, steppe, house, interior, etc. The computer in the system of this level is displayed simultaneously as: a spatial object; as a “spatial-techno-instrumental” phenomenon.

Functional features of level D – “Object actions” are revealed in 3 questions, from the 16th to the 18th. In the questions of the questionnaire, which reflect the indicated level, the phenomenology of praxis is updated, that is, purposeful algorithmized object actions or work with objects, things, tools. Accordingly, the questions of the questionnaire are updated, which relate to observations of the work of people, mechanisms, machines, as well as the results of activities – objects, architectural structures, that is, the object and machine-technological environment. The computer in the system of meanings of this level is considered as a significant component of the object-instrumental environment.

The functional features of level “E” – “Intellectual (speech) movements” in the context of HCI are revealed in 4 questions – from the 19th to the 22th. In the questions of the questionnaire, which reflect the indicated level, the phenomenology of body language, speech and, to some extent, intellectual activity is considered. That is, in the questions of the questionnaire, in which the indicated level is reflected, first of all, the meanings, values, intentions of cognition are revealed, as a manifestation of intelligent human nature and mind as the highest result of the development.

In order to determine the groups of respondents according to the body-mental orientation in the Umwelt of oriented interaction in the human-computer system, the SimpleKMeans cluster analysis method was applied using the Weka platform [39, 40]. The number of clusters was determined taking into account the results of data preprocessing [41] (table 1). Analyzing the obtained results, it was decided to divide the respondents into three groups with characteristic features according to the research topic.

Table 1. The number of clusters, determined by quality indicators.

Index	Number of clusters
Dunn	4
DB	4
SD	3
CDbw	3
S_Dbw	3

3. Results and discussion

Let us consider the theoretical and conceptual understanding of the problem of HCI based on the integrative use of the concept of Umwelt by J. J. von Uexküll [27,28], the doctrine of autopoiesis by H. Maturana and F. Varela [29], the theory of movements construction [26] and the concept of boundary-contact [37, 38]. The specificity of these concepts is that in them the interaction between man and the environment is revealed holistically, systematically, and structured. These concepts represent the specified interaction between human and the environment as a special "human-environmental" reality (world), which can also be considered as a boundary (or zone) of their active contact, which includes mutual penetration. Accordingly, to consider the interaction in the human-computer system, the specified concepts can be applied integratively and mutually complementary, which reveals and actualizes their methodological and application potentials.

To understand the interaction in the human-computer system, we apply the idea of the boundary-contact [37, 38] on Gestalt psychology. The boundary-contact is a place (zone) of interaction between a person and the environment and is presented as a primary psychological reality. Accordingly, we can suggest that one of the aspects of effective interaction in the human-computer system should be the finding of electronic devices or their sensory, cognitive, autopoiesis or other effects in the "boundary-contact" between the person and the environment. The specified boundary-contact can be not only determined ("found") but purposefully constructed. The above-mentioned concepts present us with options and opportunities for consideration and selection of such contact boundaries (zones), which can be considered both relatively constant and dynamic. This is relevant even if special devices or their effects are localized in the human body itself.

We consider HCI as a special reality. In this reality, the nature of man is revealed as a system-organizing and leading one, which, according to the concept of H. Maturana and F. Varela, is cognitive and autopoiesis (the ability to self-form and self-develop). Autopoiesis as a special quality of the living, within the framework of this study, is interpreted by us, first of all, as the ability to form an effective boundary-contact between a person and the environment and to build one's Umwelt [27, 28]. In this aspect, computer cognition, regardless of autonomy, is considered as a manifestation of the human cognitive nature transformed into a technical tool. Therefore, human cognition in the specified interaction, despite the presence of elements of dialogical interaction, we present as leading and primary. Cognition, as a special human quality, and as a way of contact with the environment [37, 38] has various manifestations – sensitive, perceptive, motor, activity, verbal, etc. It is both formed and implemented through the actualization, first of all, of sensory systems and the motor sphere, which are the basis of locomotion, speech, and activity. Therefore, human cognition in its bodily basis is sensorimotor (sensorimotor intelligence and bodily mind), which has distinct spatial and motor dimensions [37, 38]. Another defining feature of human cognition is that it is verbal, which reflects a person's special ability to create symbolic realities. The specified aspects of the human mind as a sphere in which, first of all, the inner reality is reflected, reveal it as a spatial and activity phenomenon. Human sensory systems, which, perceiving the inner reality of a person or the external world, function within certain spatial boundaries. The specified limits can be considered in the format of spatial structuring of human cognition, which can be presented layer by layer according to the specified functional specificity of sensory systems. Thus, the spatial structuring of cognition is primarily determined by the spatio-temporal specificity of the functioning of sensory systems (proprioreceptive, visual, audio, etc.). It is important that sensory systems, having a certain degree of autonomy, integrate and reveal their cognitive potential during motor activity and other activities, forming special typical "sensory-motor zones" and "sensory-motor-activity zones", which, accordingly, have their own spatial specificity. The above-mentioned features of human cognition as sensory-spatial, perceptual-spatial, motor-cognitive, neuro-cognitive-spatial, cognitive-spatial phenomena are systematically revealed in the concept of building movements [26].

According to the ideas of J. J. von Uexküll, in humans, as in any living being, there is a sensory component in the form of a receptor system (German: *Merknetz*) and an active component (which is primarily realized due to the presence of motility), which considered as a system of effectors (in the sense of active "tools") (German: *Wirknetz*). The specified systems (sensory and effector, primarily motor) are not isolated, but exist interconnected, interdependent and complementary, adjusting to each other, forming a functional circle (German: *Funktionskreis*) (the concept of J. J. von Uexküll) [27, 28]. The functional circle essentially "integrates" the organism and the environment, including its artifacts and parts. A living being figuratively speaking is in a system of functional circles that construct its interaction with the environment.

In this study, we point out that the functional circle integrates a person and a computer, which is considered in many ways – as a thing, as a special world, as a tool, as a machine and technology, as a special cognitive and emotional. Accordingly, the *Funktionskreis* can be represented as one of the aspects of structuring the Umwelt of a person, in which a computer can be present – as a "thing-instrument" (structure), as a function (cognitive, image-forming, etc.) and as a special reality, including virtual and supplemented.

The application of the concept of Umwelt [27, 28] and *Funktionskreis* [27, 28] reveal to us the possibility to understand and represent the interaction of a person and a computer as a special multidimensional, dynamic and systemic integrity. The indicated integrity can be understood and varied and described as a system of "circles of interactions" – functional circles (*Funktionskreis*). The specified *Funktionskreis* can be represented as: levels; communication channels; flows of energy, matter, information; structural and functional fragments that integrate both the components of a person (or/and a person) and the environment (including a computer, augmented reality, etc.). Thus, the concepts of Umwelt and functional circles of J. J. von Uexküll are at the basis of methodological strategies aimed at considering Umwelt-oriented interaction in the "Human – Computer" system constructively, necessarily, purposefully, which determines the variability of representations. This, accordingly, conditions the strategies of applying existing ideas and theories (and their systems) in which man and his interaction with the environment are represented systematically, spatially and multidimensionally.

One of such anthropologically and spatially oriented, intellectually refined and deep in its meanings concepts that systematically reveal the interaction of the human Microcosm (Greek: $M\iota\kappa\rho o\kappa o\sigma\mu o\zeta$) and the world of the Macrocosm (Greek: $M\alpha\kappa\rho o\kappa o\sigma\mu o\zeta$) through consideration of the "mystery of movement" (according to the theory of movements construction). We interpret this theory more broadly as a theoretical system that represents the structural and functional foundations of the human motor and partially sensory sphere. This is due to the fact that the phenomenology of the sensory sphere, without which it is impossible to understand motor activity, as well as the movement itself, which is the basis of human activity, can be represented as Umwelt. According to J. J. von Uexküll, Umwelt is a sensory-perceptual-active world. In essence, in the theory of movements construction presented one of the system options for describing the human Umwelt, in which the motor component is system-organizing and leading.

In the theory of movements construction, movement is represented: systemically – as a system represented by 5 levels (A, B, C, D, E); purposeful – that is, motor activity of each level has a purpose, including self-maintenance; hierarchical – which is reflected in the allocation of lower and higher levels (the hierarchy starts from level A in the direction to E); ontogenetically – movement can be represented as the development of the motor system in the process of individual development (ontogenesis); phenomenologically and anthropologically – with the disclosure of the anthropological specificity of the movement and the phenomenology of each level. For Umwelt's oriented examination of the interaction in the "Human – Computer" system, the contextual meanings embedded in the theory of movements construction are important. This theory reveals the spatial, temporal, regulatory, pathological, health-preserving, communicative, and existential aspects of motor activity as a cybernetic system in interaction with the environment.

We will present the understanding of HCI according to the essential characteristics of each of the 5 levels (A, B, C, D, E).

The level of tonic movements – "A" is basic (it is the basis of the "movement" hierarchy) for all other movements. Accordingly, it is present in all movements. When considering "Level A" as a *Funktionskreis* (functional circle), it will be represented as a sphere and/or circle that encompasses a person both within his body and at a relatively short distance from the body. This level integratively represents many human spheres, systematically revealing human nature, namely: existence as a bodily given; the connection of the body and motor activity with the archetypal level of consciousness, including the collective unconscious; vitality manifested in tonic movements both in statics (sitting, standing) and in dynamics; thalamic emotions (including emotions close to pathological ones), which are mainly interpreted as positive "+" or negative "–" and reflect the state of health, vitality and to some extent can signal the future; anticipation (prediction of the future), which is manifested in a barely noticeable change in tone, in thalamic emotions; state of vital organs and systems; sensors and perception (including the level of sensations and integral sensory and perceptual images of images) in the formation of which participate – proprioceptors (located in muscles and their tendons), interoreceptors (localized in internal organs); noceoreceptors (pain); skin receptors. The functional purpose of the indicated level "A" is to maintain the organism itself in a biologically "optimal" state. This is realized by ensuring the regulation of muscle tone, which we can feel during palpation in any area of the body where there are muscles, including facial muscles. Muscle tone, which is present in the entire body where there are muscles, in the absence of pathology is regulated automatically, representing one "tonic" integrity. A person's understanding of himself as a special integrity and continuity can be represented as the self, which is perceived as "higher integrity" we believe is connected with the state of level "A". This level is continuous in time – it is always there, and it is also unbreakable in its inner space.

We present the interaction between a computer and a person at the "A" level as *existential-bodily-motor-tonic*. A computer at this level can be perceived and interpreted neutrally ("invisible"), positively ("+") or negatively ("–"). An ambivalent "mixture" of the specified response options is possible. Accordingly, this will also manifest itself in an increase in the risks of computer addiction formation, if there is a "totally" positive "+" perception. Because the entire "inner world" of thalamic emotions and deep (in the sense of interoceptive) sensors and perception due to the potential of plasticity (including the ability to adapt) is accordingly modified under the influence of "computer connotations" (in the sense of long-term but weak influences). A negative "–" perception of a computer can be formed due to the fact that at the subconscious level it can be perceived as a "non-living entity with signs of a living one". The body will perceive it ambivalently as "+" and "–", respectively, which can generate tension, fear and anxiety, respectively. Negative emotional states that cannot significantly affect mental reality are indicated. Accordingly, as a result of hypercompensation and psychological defense mechanisms, such weak effects of the "computer" on the subconscious can transform into a tendency to addiction and a "hyperpositive" attitude towards the computer. Drawing analogies, we can say that at the level of cell biology, a virus acts in a similar way, which is often incorporated into the cell's genome.

This level "A" is the most "true", it is the "level of alateia" – truth (Greek: $\alpha\lambda\eta\upsilon\varepsilon\iota\alpha$) and being. It accurately reflects the state of the body and, above all, of the nervous system and psyche, including hidden problems. Psychological and other life problems can be transformed into physical problems, a typical variant of which is muscle clamps, which can collectively form the so-called "character armor" [33]. Muscle clamps are formed primarily at level "A". As an example, we note that interaction with the specified level is used when working with a polygraph. Level "A" mainly determines the individual specificity of handwriting, gait, and voice. Purposefully changing these phenomena (for example, handwriting) is quite difficult, and in most cases it is not possible. If the handwriting changes, the intonation of the voice changes, then mostly the person changes deeply and totally.

We will present one of the variants of the spatial structuring of level "A". The specified structuring is carried out on the basis of a structural-functional approach, which includes, first of all, integrative consideration of morpho-physiological characteristics and spatial factors. In the spatial aspect, level "A" has several boundaries, which can be represented as the boundaries and/or zones of reception and contact between the body and the computer. These boundaries can also be represented as anthropomorphic stereometric figures, "spatial spots", or within the framework of a mathematical model as clusters. The indicated boundaries/zones, which cover both the whole body and partially the environment, reveal the anthropic-computer-environmental specificity of the functional circle that corresponds (more precisely, it is formed with the participation of this level) to this level "A". The presented boundaries/zones accordingly structure this level, "immersing" both in the "organism-body" and "spreading" into the environment. That is, under this consideration, the body is not rigidly limited by the surface of the skin. We distinguish the following boundaries/zones ("clusters of reception and interaction"): 1) the zone close (*of electromagnetic and field interactions*) to the body and located at a relatively short distance from the body surface and represented by electromagnetic radiation, which accordingly also has its own spatial specificity, which is determined area, time and state of the body, as well as to a certain extent it is "constructed" by the psychological field as a manifestation of human nature (according to K. Levin's concept); 2) limited to the surface of the human body (skin surface) (*superficial*); 3) the border (*of skin sensitivity*) is formed by skin receptors located in the skin itself; 4) border (*proprioceptive*) (in essence, a receptor shell or space), which is formed by proprioceptors of the muscular system; 5) border (*interoreceptor*), formed by receptor systems of internal organs and vessels. Interaction with the computer is carried out both according to the presented sequence (from the 1st to the 5th border) and in any other. "Body-computer interactions" are relevant, which can be revealed with the integrative use of K. Levin's concept of the psychological field and the above-mentioned borders/zones (levels), which we consider as anthropobiologically determined "matrices and/or typical ways of interactions".

Level "A" is also characterized by certain vibrations with corresponding rhythms, which are mostly low-amplitude and relatively high-frequency. Due to the specified outwardly imperceptible "vibrations" of the muscular system as well as the body itself, a relatively stable state of a person is maintained at rest (static movements – sitting, standing) and during dynamic movements. That is, barely noticeable muscle oscillations, which are caused by constant harmonized and relatively rhythmic switching of individual muscle fibers, form dynamic balance, for example, when standing or sitting, which are one of the manifestations of level "A". You can also notice the manifestation of this level when a person shivers in the cold, when the structure of vibrations changes with increasing amplitude. These automatic neuromuscular processes aimed at maintaining tone are mostly not realized by a healthy person. The understanding of the importance of this level as a vital problem appears when violations occur in the indicated "level A", for example, in Parkinson's disease, cerebral palsy, etc. Rhythms and vibrations of the level of tonic movements "A" can form their "imperceptible" interactions with the computer as a technical system, including synergies, adjustments, violations of certain rhythms, etc. This is due to the presence in modern computers as complex technical systems of their specific vibrations and rhythms both at the level of electrical, electromagnetic and mechanical processes.

Temporality of the indicated level is understood as temporal continuity and givenness, which determines the understanding of time as eternal, forming the effect of integrity in time and as its own time (subject time) acceptable and "comfortable" for a person. This understanding of time among the ancient Greeks was defined as Kairos (Greek: $K\alpha\iota\rho o\zeta$ – favorable time), it is perceived as a harmonious temporal existence. A similar understanding of time is defined in the format of existential temporality. Time becomes noticeable and understood as an existential issue when problems arise in the indicated level "A", before that it is not "noticed". The rhythms that are formed during the interaction in the human-computer system can enhance the effect of temporal well-being – the perception of time as Kairos, or transform it into linear temporality – "Time-Chronos", which can subjectively be perceived as a threat to the reduction of "time-resource", loss of existence and threat to existence.

The indicated level "A" is also connected with the understanding of one's "I" as an individuality, as a given, as existence (in particular, existential corporeality) and physicality. According to this interpretation, it is important that this level is quite closely connected with the collective unconscious. To clarify, let us recall that the collective unconscious is, first of all, a connection and some kinship between people at a deep subconscious level, which can be manifested in typical stereotyped formats of perception, understanding, action and behavior – archetypes (according to C. Jung) [35, 36]. The specified archetypal dimension of the psychic, which is manifested to a certain extent through the "A" level (tonic movements) can also be presented as a specific feature of the human Umwelt, which spreads like a rhizome (mushroom) (according to J. Deleuze and F. Guattari) [34] for a significant part of humanity, while having typical manifestations in each individual – archetypes.

A computer can be a significant and positive, neutral or, conversely, negative artifact, a part of the human, an archetypal phenomenon, a "living" or a dangerous "inanimate" object. A similar perception and understanding of reality, which is defined by bodily-existential, bodily-tonic and vital levels, exists in childhood and is often manifested in extreme and pathological conditions. This interaction between a computer and a person, which is realized through the level of tonic movements ("A"), we define as *existential-bodily-motor-tonic*.

The state of the specified level, including manifestation through the unconscious dimension of mental reality, can transform into higher levels (B, C, D, E), manifesting in them. Accordingly, for the synergistic or antagonistic interaction of the computer with the "A" level, we can use the effects on various sensory-receptors and sensory-perceptive systems. The influence of technical means on receptors and analyzers can be relevant: tactile, vibration, stereognosis, noceoception, temperature, proprioceptive. It is also possible to influence the auditory analyzer (music, conversation, isolated sounds and sound backgrounds) and, to a lesser extent, through the visual analyzer (visual images – pictures, landscapes, images of things and structures). The impact on sensory-perceptual processes can be implemented based on the use of relatively simple, primary, "elementary" images (audio, visual), colors, signs, symbols, rhythms and their combinations, as well as archetypal images, influences and figures. What is relevant is that this level is constant, and the neurophysiological and neurohormonal processes that largely determine it (at the level of biology) determine its inertia. Therefore, external influences have an inertial and delayed character in various terms, manifesting themselves after some time. This level is "closed" to direct influences, it reflects the constancy of life itself and its self-sufficiency.

We have presented in general terms one of the variants of the layered, multidimensional, spatial and partially temporally oriented structuring of the level of tonic movements as a special Umwelt (which is a structural-functional and spatial-temporal and sensory-perceptual-cognitive-activity structuring of human interaction with the environment) and as a functional circle (functional sensory-perceptual-activity structuring) in order to take into account the specified features in the design and operation of computers, as well as in the development of software and interfaces.

Level B – "Synergistic movements" reveals the phenomenology of motor activity based on typical patterns (patterns, patterns, "stamps") (according to the theory of movements construction) [26] and rhythm. The leading characteristics of the movements of this level are that they are: rhythmic (as if "pulsating"); repetitive, i.e. those that are accordingly reproduced as certain patterns ("stamps"); balancing; can create an effect of continuity; include mainly large areas of the body; those that are carried out without moving in space; reciprocal, which are implemented by successive and alternating contraction of muscles (for example, when walking), which forms a certain rhythm. The defining feature of level "B" movements is synergy, which is based on repetitive, interdependent, reciprocal and at the same time on multidirectional and ultimately harmonizing and balancing motor activity. An example of this level "B" movement is balancing, walking (meaning repetitive movements during walking).

These movements reveal to us the beauty, harmony of a person and the topological nature (as inseparability and plasticity) of his body, which, accordingly, has projections into mental reality. Due to its topological nature, the human body can change in space, remaining inseparable, whole and not losing its characteristics. In spatial terms, synergies occupy the space defined by the body itself. To some extent, an illustration of human interaction with space at this level "B" is the famous Virtulian man (Italian: *L'uomo vitruviano*) by Leonardo da Vinci (figure 4). In essence, the space delineated by the human body in the case of synergies is similar to a sphere, an egg, or, more precisely, to a certain spatial spot (closer to a sphere), which can change dynamically. We define the representation of this level of "B – synergistic movements" (according to the theory of movements construction) as a partial component of the human Umwelt as a synergistic-topological-fractal Umwelt. This understanding is due to the fact that, in addition to spatial continuity and inseparability as topological features, movements of a given level form not only movement patterns (in the sense of typical movements) but also, to a certain extent, repetitive and complex spatial movements that cannot be formally reduced only to typical sample More precisely, the sample has many variations in scale, amplitude, trajectory. In addition, the projection of this level into psychic reality, as well as the manifestation of the psychic through this level, manifests itself in rhythms and certain phenomena, which can be partially represented using the concept of fractals. In this way, the *synergistic-topological-fractal* Umwelt manifests itself as a spatial, temporal, vital continuity, rhythm and pulsation in the space close to the body. This includes "spontaneous" but at the same time expected structuring of space based on typical but variable movements, actions, images (visual, audio, motor). This level of human Umwelt can also be metaphorically represented as rhythmic-musical-choreographic or rhythmic because it is based on typical, repetitive oscillatory movements with a fairly significant amplitude. Synergies are the basis of dances, as well as moves – rhythmic, oscillating, balancing economical movements with a relatively simple algorithm.

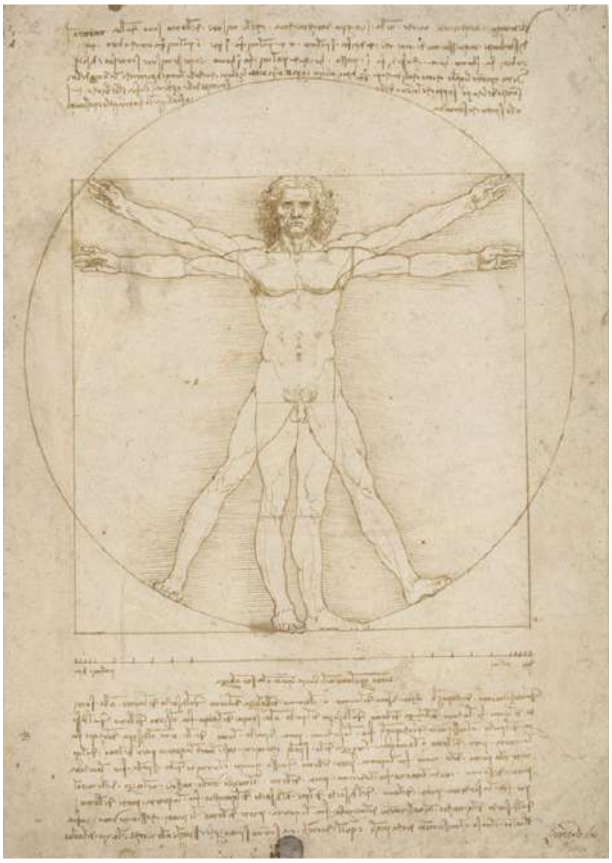

Figure 4. Vitruvian Man. Leonardo da Vinci, 1490. Gallerie dell'Accademia, Venice [42].

Thanks to this level "B", human temporality becomes "embodied", transforming into motor activity, which a person can comprehend in bodily-motor and visual-bodily images and rhythms. Time ceases to be only a "comfortable", "eternal" and "young" Kairos, reflecting the "Eternal" and relatively unchanging existential "Is", which is not sufficiently comprehended at the "A" level. The subjective time and temporality of this world is revealed simultaneously as Kairos (continuous, boundless and "eternal" time) and as Chronos (Greek: $X\rho o\nu o\zeta$) (as discrete time that can be structured into equal fragments and time that a person understands through rhythm).

The synergistic-topological-fractal Umwelt integrates space, time, vitality, corporeality, existence in human consciousness as a continuous rhythm and flow of life, manifested in synergistic movements ("level B") through which human nature manifests itself brightly and expressively. This fragment of the Umwelt is also reflective in its essence, it reveals a person's view of himself, his body, movements and being; looking at oneself; understanding oneself in the world. This is manifested through the "structuring of time through space" and "structuring of space", which is realized precisely thanks to "synergistic motor actions" (authors' interpretation) in which there is rhythm, repetition, reproduction of typical motor images, etc.

When structuring this synergistic-topological-fractal Umwelt layer by layer (as in the previous level "A") as a border/zone with the inclusion of body-receptive components, we define: 1) the space is limited by the surface of the body and the movements of the outstretched limbs (although usually this space is somewhat smaller because the larger part of the movements of the limbs is realized not in an extended, but in a slightly bent position), it partially coincides with the zone formed by electromagnetic radiation of level "A"; 2) the zone/boundary (more precisely, the body), which is represented by the proprioceptors of muscles, tendons and partially ligaments (almost corresponds to the 3rd zone of level "A") of the musculoskeletal system; 3) zone/boundary (body) (*vestibular-balancing*), which is determined by the vestibular analyzer and systematically interacts with "zone 2" represented by proprioception. To clarify, we note that the indicated 3rd *vestibular-balancing* border/zone has several localizations: in the format of the whole body as a "filled with weight" dynamic spatial object; parts of the body as "filled with weight" dynamic spatial objects; as body zones of "attraction", which can be represented in the form of limited localization – dots, spots, etc. For example, a person does not sufficiently differentiate and understand his general center of gravity, which can move during movement.

The level of synergistic movements due to vestibular perception actualizes and makes sense of the top/bottom relationship, which determines the vertical orientation of the body and, accordingly, the Umwelt. The top/bottom relationship becomes a significant bodily metaphor, which is a manifestation of both the human body and the Umwelt. This relationship contributes to the spatially oriented understanding of oneself as bodily reality, as bodily existence, the surrounding world and is transformed into culture as a significant indicator and "filler" of meanings, becoming an aspect of bodily cognition. These ideas about the role of the body in the formation of human cognition and speech are revealed by J. Lakoff [24, 25], focusing on bodily metaphors. In this way, the Umwelt acquires a spatial orientation based on the understanding of the top/bottom relationship. The specified aspect of spatial orientation and the "archetypal" (in the sense of deep) significance of the top/bottom relationship can be purposefully applied in the development of software and interfaces.

At this level "B", which determines the specificity of the synergistic-topological-fractal Umwelt, the receptor systems of internal organs (interoreceptors) and skin (skin receptors – tactile, pain, etc.) are not relevant. They can only partially determine the specificity of the synergistic-topological-fractal Umwelt, "helping" to realize proprioception. That is, this Umwelt is, as it were, a projection of the body in the narrow sense as a locomotor apparatus, "a body without organs." With some irony, we can also use J. Deleuze's metaphor – "bodies without organs" for its characterization (as well as the description of Umwelt).

The interaction between a person and a computer, which is implemented at the level of the synergistic-topological-fractal Umwelt (in the theory of movements construction, it corresponds to the "B" level and is mainly formed by it), will include, first of all, taking into account its specific characteristics. This means that the development of computer equipment, software, interfaces and modes of operation must take into account the phenomenology of: rhythm; topology as inseparability, continuity, plasticity and fluidity; repeatability; fractality; circular and rhythmic movements; temporality; harmonization with the environment.

We will present the theoretical understanding of the following levels C, D, E within the framework of this study somewhat abbreviated and generalized. Level "C – spatial movements" reveals to us the phenomenology of human motor activity through the realization of its spatiality and being in space through movement, visuality and audiality. Accordingly, metaphorically, a person (his spatial nature) who corresponds to this level "C" is represented as a Spatial Man (Latin: Homo Spatialis) and a Locomotor Man (Latin: Homo Locomotrius). Walking, running, jumping are the main movements realized thanks to this "C" level. Due to the fact that visual sensors and perception at this level are the determining spatiality of a person, it is manifested through interaction with spatial objects, landscapes, landscapes, both real and virtual. Level "C", together with the visuality and audiality of a person form a *special spatial Umwelt*. In this spatial Umwelt, the motor-visual and visual-spatial component may dominate, as for example in people with hearing impairments, or the auditory component may prevail as in people with visual impairments. With typical development, there will be harmonized, complementary synergistic interactions between the audio and visual components, which must be taken into account when developing and operating computer equipment and software.

The computer in the system of this level is displayed simultaneously as: a spatial object; as a "spatial-techno-instrumental" phenomenon that can shape ("generate") spaces and spatial things; as a way or "machine" to move in virtual spaces. Consideration of space (primarily virtual) in the format of instrumentality is emphasized – as "spatial-instrumental", which is both a manifestation and a result of the "human-spatial-computer" way of working (interaction) (formation, contemplation, interpretation) with spatial objects. Space (virtual and real) in the "C" level system acts as an effective way of integration, synergy, synchronization in "human – computer" systems. The spatial-instrumental nature of interaction in the human-computer system determines the actualization of the phenomena of spatial orientation, spatial thinking and perception, and will and intentionality. In the semantic framework of the phenomenology of the human Umwelt as a spatial phenomenon, the computer acquires the format of a "collapsed" "space-world", a tool-space that can variably unfold (install) forming various visual realities-spaces. Accordingly, the computer is considered as a special space-producing ("creative") thing or machine, which determines the "quasi-vital" (as an imitation or perception of a living) understanding of the computer by a person and reveals its "techno-creativity" and "techno-cosmism" (as the ability to generate harmonized and "completed" realities and spaces). Accordingly, it will be relevant to consider the computer as a phenomenon forming a dialogue in space, with space and thanks to space. This is realized, first of all, thanks to its "spatial-instrumental" capabilities of the computer as a machine "shaping" the existing spaces within the limits of the human Umwelt and consciousness.

Level D – "Object actions" reveals the phenomenology of praxis. The significance and essence of praxis can be metaphorically and systematically presented in the anthropological format as the Skilled Man (Latin: Homo Habilis). Praxis is purposeful, algorithmized, consistent in nature objective actions and/or work with object, hand tools, to some extent with the environment (materials, etc.). The computer in the system of meanings of this level is considered as a significant component of the object-instrumental environment, which we present in the Umwelt format. The computer in the system of this level will be presented as a special "multifunctional" activity tool. We define this Umwelt-oriented aspect of interaction in the human-computer system as a *constructive-praxical-instrumental Umwelt*. Due to the rapid evolution of technologies and equipment, including the technologization of all spheres of life and human activity, one of the manifestations of which is digitalization, the specified level will acquire "technological connotations" and will be presented as a *constructive-practical-instrumental-technological Umwelt*. Traditionally, this level is understood in the formats of ergonomics of computer equipment and as software design, although in its essence it is much broader, multifaceted and multidimensional.

Level E – "Intellectual (speech) movements" is represented by body language, language, and, to some extent, intellectual activity. Intelligence, despite its autonomy, is ontogenetically (in the sense that in a person, in the process of individual development, verbal intelligence is formed on the basis of sensorimotor) and partly functionally (as an example, the concept of the bodily mind of J. Lakoff) [24, 25] connected with the bodily-motor human dimension. In the theory of movements construction, cognition as an attributive and determining specificity of human nature has bodily-semiotic (for example, complex dances, body language), semiotic-semantic, communicative-cognitive (speech, communication, sign systems and thinking) and figurative-semantic representations. The computer in the meaning system of this level is considered as a significant component of the cognitive dimension of Umwelt-interaction in the human-computer system. Based on the consideration of its implementation and existence, we present the specified interaction mainly as instrumental and cognitive. Accordingly, we define it as the *instrumental-cognitive Umwelt* as the dominant one. The computer in the system of this level will be presented, first of all, as a special "multifunctional" tool of intellectual activity, although other aspects are also present. Traditionally, interaction in the human-computer system is mainly considered in the dimensions of cognition and/or as cognitive or cognitive-communicative interaction.

A study was conducted by surveying students and teachers of higher education institutions of Ukraine using the "Fedorets-Klochko Questionnaire was used to determine the body-mental orientation in the Umwelt oriented interaction in the human-computer system". Research was conducted in 2022 at: Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University; Public higher educational establishment "Vinnytsia academy of continuing education"; Communal Institution of Higher Education "Vinnytsia Humanitarian and Pedagogical College"; Berdyansk State Pedagogical University. 87 respondents took part in the study. The purpose of the study was to determine the physical-mental orientation in the Umwelt of oriented interaction in the human-computer system. The survey results were processed using cluster analysis, three clusters were obtained (table 2, figure 5).

Table 2. The cluster model to determine the groups of respondents according to the body-mental orientation in the Umwelt of oriented interaction in the human-computer system, built using the SimpleKMeans algorithm. (Correspondence of the markings of the vertical axis: "-1" corresponds to the answer "No"; "0" – "Can't decide"; "1" – "Yes, to a small extent"; "2" – "Yes"; "3" – "Yes, to a large extent".)

Question number	Cluster № 0, 28%	Cluster № 1, 35%	Cluster № 2, 37%
1	2	2	2
2	-1	-1	-1
3	-1	-1	-1
4	-1	0	-1
5	-1	0	2
6	-1	1	-1
7	-1	3	3
8	2	1	2
9	-1	1	1
10	-1	0	1
11	-1	0	1
12	-1	1	0
13	-1	1	2
14	-1	1	2
15	-1	0	2
16	-1	0	2
17	-1	1	2
18	-1	1	2
19	1	2	2
20	-1	2	0
21	-1	1	2
22	1	1	2

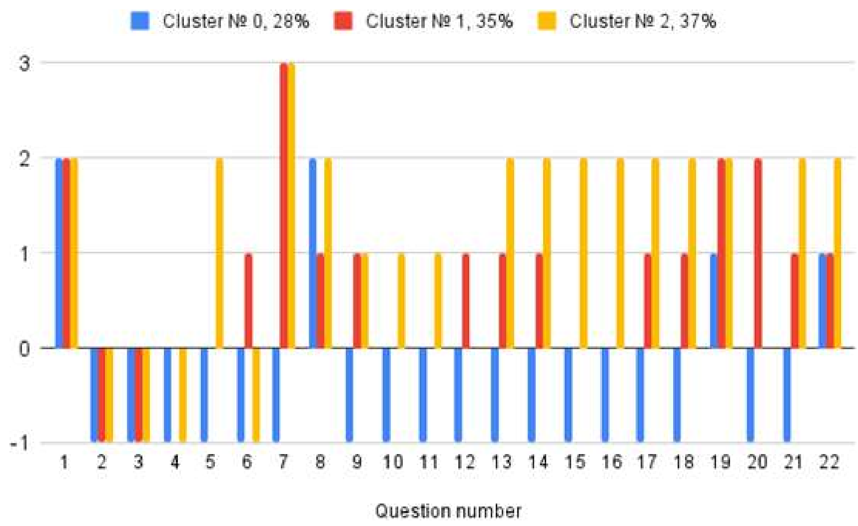

Figure 5. The value of the centroids of the clusters according to the question number "Fedorets-Klochko Questionnaire was used to determine the body-mental orientation in the Umwelt oriented interaction in the human-computer system", presented in the form of a bar chart (Correspondence of the markings of the vertical axis: "-1" corresponds to the answer "No"; "0" – "Can't decide"; "1" – "Yes, to a small extent"; "2" – "Yes"; "3" – "Yes, to a large extent").

Cluster 0, which is formed by 28% of the respondents, is mainly represented by negative answers. The answers to questions № 1, № 8, № 19, № 22 were positive. From Umwelt's point of view of oriented interaction in the human-computer system, the specified structure of answers, to a certain extent, indicates the dominance of interaction that is cognitive in nature. This corresponds to the level of intellectual movements "E" in the theory of movements construction.

Cluster 1 is formed by 35% of the subjects. The cluster is mostly dominated by positive answers. The presence of neutral answers to 6 questions is also relevant. № 4, № 5, № 10, № 11, № 15, № 16. These neutral answers are correlated with different zones of the body-mental Umwelt of a person, which is structured according to the theory of movements construction. The correspondence of neutral answers to the levels of movements according to the theory of movements construction will be as follows: № 4 and № 5 – level "A – tonic movements"; № 10, № 11 and № 15 – level "C – spatial movements"; № 16 – level "D – substantive actions". The specified distribution of neutral answers relative to the specified levels A, C, D indicates insufficiently actualized Umwelt-oriented interaction in the human-computer system at the specified levels. At the same time, compared to "Cluster 0", the specified interaction is formed at all levels, including A, C, D.

Cluster 2 is formed by 37% of the subjects. Cluster centroids are mostly positive answers. It is relevant to have neutral answers in 2 questions. The distribution of questions by levels (according to the theory of movements construction) is as follows: question № 12 corresponds to the level "C – spatial movements", and question № 20 – to the level "E – intellectual movements". In this cluster, there is a certain growth of Umwelt-oriented interaction in the human-computer system, which is relatively evenly distributed across all levels.

In clusters 0, 1, 2, the zone in which the Umwelt-oriented interaction in the human-computer system is not sufficiently updated is the "C – spatial movements" level. This indirectly indicates the perception of the computer, mainly as a thing, a tool and at the same time as a cognitive phenomenon, and not as a special space or "forming" virtual spaces of the tool.

In clusters 0, 1, 2, the zone in which the Umwelt-oriented interaction in the human-computer system is most actualized is the level "B – synergistic movements" and the level "E – intellectual movements". We interpret it in the following way – level "B – synergistic movements" – forms rhythms, rhythmic repetitive movements ("stamps" according to the theory of movements construction). This level, in our opinion, is connected with music and is manifested (according to the theory of movements construction) through dances and rhythmic movements (walking; working in a certain rhythm, for example typing). Rhythms and synergies of this level are synchronizing, harmonizing, integrating when interacting in the human-computer system.

The level "E – intellectual movements" is defining and system-organizing, in which there is the most intensive and constant Umwelt-oriented interaction in the human-computer system. Such interaction is consistent with the intellectual nature of man as a rational being (Latin: Homo Sapiens) and relative to the instrumental-cognitive "essence" and purpose of the computer.

4. Conclusion

The anthropologically oriented result of the methodological and conceptual reflection of the interaction in the human-computer system based on the integrative application of the concepts of the Umwelt of J. J. von Uexküll, the functional circle (German: Funktionskreis) and the theory of movements construction in general terms has been developed the concept of a person's bodily-cognitive Umwelt – the sensory-perceptual-cognitive-active world. When developing the model of the corporeal-cognitive Umwelt, concepts were used that reveal the "corporeal-cognitive" nature of a person holistically, systemically, autopoietically and in relationship and through the meanings of harmony with the environment. In addition to the above-mentioned theories, the following concepts were applied in the development of this model: body mind by J. Lakoff, enactivism, functional systems, autopoiesis by H. Maturana and F. Varela, body without organs by J. Deleuze, archetypes of C. Jung. The body-cognitive Umwelt of a person is structured according to the theory of movements construction into five levels, which are simultaneously considered as functional circles, as relatively constant flows of information and energy, as well as as topological and fractal structures.

The integrative use of the Umwelt concept and the theory of movements construction for the analysis of possible ways and features of interaction in the human-computer system represents one of the options for structuring the specified interaction. An important aspect of this is the selection of certain zones of such interaction, presented in the format of levels, which determine the specifics of the indicated interactions. Taking into account the specifics of each of the levels is the way to form the ergonomics of interactions in the human-computer system, taking into account human nature, including psychology. Integrative influence on levels is a way of organizing multi-channel human-computer system interaction (we consider the levels of the human Umwelt selected by us as zones of multi-channel system interaction between a human and a computer).

The body-cognitive Umwelt is structured according to the theory of movements construction into five levels, which are simultaneously considered as functional circles, as relatively constant flows of information and energy, as topological and fractal structures, as special spatial, temporal, sensory, perceptual, motor, cognitive and activity worlds of a person. Each level of the bodily-cognitive Umwelt has its own specific autonomy and system characteristics, the knowledge and understanding of which can be purposefully used for anthropically oriented improvement of interaction in the human-computer system. We consider the levels of the human Umwelt identified by us as zones of multi-channel system interaction between a human and a computer. The characteristics of the bodily-cognitive Umwelt, as well as its relatively autonomous levels, can be purposefully used in the development of: software, Umwelt-oriented digital technologies and interfaces, in the design and design of computers, robots, smart environments (educational, homes, cities) and also when organizing work and life in the new digital world. This becomes especially relevant in the conditions of the global Covid-19 pandemic, as well as in the implementation of: sustainable development goals, including greening; NBIC convergence and other challenges.

A study of Umwelt oriented interaction in the human-computer system was conducted. For this, the "Fedorets-Klochko Questionnaire was used to determine the body-mental orientation in the Umwelt oriented interaction in the human-computer system" was used, the results were processed using cluster analysis. The interpretation of the research results indicates the systematicity and level of interaction in the human-computer system. This determines the possibilities of distinguishing typical paths and spheres of interactions in the human-computer system, among which the bodily and mental-psychological ones are significant, corresponding to certain levels that correlate with the systemic, spatio-temporal and structural-functional organization of motor activity in the theory of movements construction.

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