Cybersport within non-classical ergonomics of immersive and interactive environments

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Abstract. The article is devoted to non-classical ergonomic of eSports. The theoretical foundations of non-classical and post-non-classical ergonomics of immersive and interactive environments are considered as applied to the activities of cybersportsmen. It is shown that the use of tools and the conceptual basis of classical ergonomics and engineering psychology are not enough to consider the self-organizing processes of mutual orientation of the gameplay participants in an artificial dynamic environment of activity. The new conceptual basis includes philosophical and natural science positions of radical and epistemological constructivism, which allows considering the recursive processes of autopoietic self-organization that take place in the subjective and communication sphere of gamers in the process of achieving a game result from a unified systemic position. The issues of professional training of gamers, the inclusion in the gaming environment, immersiveness and interactivity of artificial environments are considered. The problem of presence in the game world as criteria for the incarnation of the gamer's “I” in the “I” of an effective game character is analyzed.

1. Introduction
Development of technologies for information processing and presentation led to the creation of computer games that unite gamers in a single gaming environment using network technologies, which was the beginning of the massive development of eSports [1]. In artificial gaming virtual worlds, an illusion of the presence and complete immersion of a gamer in the plot and environment of the game is created, which starts the work of his psychophysiological and cognitive mechanisms in the direction required by the script. An e-sport (cybersport) industry appeared. Its development required the involvement of knowledge and technology from various areas of technical and humanitarian knowledge in order to improve the means of imitation and enhance the emotional impact on the audience. In the first place, this concerned the creation of computer games scenarios generating the achievement motivation, which required an unconditional knowledge of the foundations of psychology. In addition, a significant role was played by experts in the field of design and technical aesthetics, engaged in the problems of ensuring the interactivity and aesthetic qualities of the gaming environment. Note that the gaming environment does not necessarily have to exactly repeat a certain physical world similar to the world of human activity, but it should present at least minimal opportunities to conduct competitive activities, realizing the motive to achieve some goal understood and accepted by gamers.
The spontaneous nature of appearance and organization of gaming community at the initial stages of its development did not suggest any advantages to its participants due to the possession of specially designed interfaces and a workplace organized in accordance with the requirements of ergonomics. There was a natural selection of the best gamers based on the games results, each of which used its own tactics, strategy and means of achieving goals. They became carriers of gaming experience, which was transmitted in the process of gaming communication and communication between gamers. However, over time, due to increased competition and the scale of gaming activities, appearance of eSports, it became clear that ergonomically improved controls and information display allow gamers to have significant advantages over opponents. This led to the emergence of specialized gaming workstations that use powerful computers with advanced graphic capabilities, with a more advanced workstation, controls and manipulation. All this showed the emerging need for ergonomic knowledge related to the design of the working environment of the gamer. However, it should be recognized that the artificial world of the game should be ergonomic, since arbitrary projects that do not take into account the specifics of including a gamer in the game can have a significant destructive effect on his body and psyche [2]. There arose not only issues of designing and organizing a gamer’s workplace (physical ergonomics), but also more serious issues of creating a dynamic environment of activity and optimization of interface systems connecting the gamer to the game world. There were problems of training gamers, including them in the gaming environment, ensuring gaming interactivity, communication and motivation, translating into an effective game character, etc.

These issues cannot in principle be solved by the methods of design, classical ergonomic design and usability, since the methodological basis of these disciplines is mainly engineering, cybernetic and informational representations and models. This is completely insufficient for the effective design of complex systems that immerse the user in artificial gaming environments of activity [3].

2. Problems and phenomenology of gaming

The main task of the designer of the artificial world of a computer game is to create an interactive environment including (immersing) the gamer in dynamic content, perceived and interpreted by the subject as a certain reality in which the participants of the game involved in the joint activity are present and interact interactively. The interaction is carried out according to certain rules with the help of real governments that have their virtual counterparts and tools in an artificial environment, through which the observed effect on the virtual participants (avatars) and the objective world of the game is provided. In contrast to the environment of the natural world of our life, the environment in the world of computer games is a complex multi-level system, perceived by the participant as something to be studied and used for personal gain to achieve the game result. In essence, the game can be considered as an unproductive form of human activity in the artificial world, aimed at the effective use of its resources in the interests of achieving the goals of the game and the personal growth of the gamer. In the process of the game, an individual history of the participants is realized, who acquire a social status and position in the artificial world, realizing the motives of achievement. The most popular gaming platforms used in eSports are: Dota 2 (tournaments ESL One Birmingham, MDL Changsha Major, Epicenter XL, WESG 2017, DAC and The Bucharest Major), Counter-Strike: Global Offensive (World Electronic Sports Games tournaments, support of Electronic Sports League, SL i-League StarSeries, ELEAGUE Major, etc.), League of Legends (League of Legends World Championship tournaments), Overwatch (tournaments Major League Gaming, DreamHack, and Intel Extreme Masters). All of them have widely branched game worlds and historical lines of plots, create equal conditions for all participants in the game.

Note that the immersion into the game world does not pass without a trace for the gamer, since gaming effects occur, reflecting the processes of personality modification in the face of the physical and social factors affecting the game. First of all, it should be noted that these phenomena are often associated with the form of psychological gambling addiction [4]. The following phenomena are observed:

- Well-being or euphoria at the computer;
• Inability to stop;
• Increased amount of time spent at the computer;
• Neglect of family and friends;
• Feelings of emptiness, depression, irritation not at the computer;
• Lying to employers or family members about their activities;
• Problems with work or study [5].

At the same time, these signs, in our opinion, can be interpreted as signs of a person’s transition to another artificial sphere of life activity, in which a gamer has a new sense of presence, activity and readiness for action. It is these indicators that reflect the subject’s involvement in the game world. The engaging properties of the gaming environment can be so strong that it becomes for the gamer a complete substitute for reality and leads to pathological processes of social self-isolation. It is necessary to counteract the negative influence of gaming through the organization of the gaming environment and communication, the formation of the professional community of cybersportsmen.

Classic ergonomics works well when creating games with low levels of immersiveness and involving effects, but it is not effective when developing highly immersive environments that trigger mechanisms of environmental and personal self-organization. To solve the problems arising in highly immersive gaming environments, which include the MOBA (Multiplayer Online Battle Arena) and RTS (Real-time Strategy) genres, new theoretical schemes are required that take into account the complex, recursive, self-organizing nature of the communicative processes arising in gaming environment.

3. Fundamentals of the theory of immersive media

The way out of this situation may be referring to methods of non-classical and post-non-classical ergonomics of complex systems, reflecting the views of man and communication as self-organizing and developing systems of autopoietic type, creating and realizing the individual history of the subject [6]. Further we consider the main provisions of these concepts and the possibility of their application in the creation of e-sports technologies.

Post-non-classical ergonomics of immersive environments is based on the ideas of radical and epistemological constructivism, synergetics, second-order cybernetics and autopoietic self-organization and philosophy of complex systems (V.I. Arshinov, J. Gibson, E.N. Knyazeva, S.P. Kurdyumov, V.A. Lektorsky, S.A. Tsokolov, P. Watzlawick, E. Von Glasersfeld, K.J. Gergen, F. Varela, N. Luhmann, H. Maturana, I. Prigogine, H. Haken, H. von Foerster, C.H. Waddington, M. Eigen) [7].

They develop philosophical and natural science concepts reflecting the processes of self-organization in man and society, determining the type and properties of mental reflection and social self-organization. They determine the activity of a person. It is fundamentally important to define the concept of “environment”, which becomes the result of human constructive activity and is associated with the processes of its vital activity [8], and is not simply a physical structure, as it is considered in classical ergonomics.

The following interpretations of the term “environment” are used:

• The environment of the ergatic system is a product of constructive activity of the psyche of the human operator and cannot be considered outside its mental content;
• The environment reflects the phenomenon of dynamic integrity of cyclically forming chains of a person's relationship with physical and social realities in the process of ensuring his life activity, speaking to the subject simultaneously as a subjective reality and as an external objective, objective structure of the world in which the subject acts;
• The environment of activity in the content plan always arises as a dynamic process of forming networks of relations in the subject. Various elements of the external and/or internal environment are selectively involved in this process in order to ensure autopoiesis of the organism, stability of the personality, and continuity of its history.

The environment is a theater of activity, on the scene of which events are occurring which are accessible to an external observer describing the subject's behavior. We note a number of important properties of self-organizing media:
• Redundancy and observability;
• Accessibility to cognitive experience (constructibility);
• Out-of-subject spatial localization;
• Autonomy of existence;
• Media synchronization;
• Integrity of the environment;
• Environmental mobility.

Redundancy, as a property of the environment, allows the autopoietic system to reproduce itself and preserve the organization with a variable structure and elements, a plurality of relationships with it, the result of which is the construction of a certain picture of reality. Redundancy is one of the properties that allows us to consider an entity as an environment. The surrounding physical environment is fundamentally multivalued with respect to its objectivity, its laws and meanings generated by the acting brain. Observability is a consequence manifested in the process of constructing reality. That which is not observable is not the environment, although it may be present in physical reality. As an observer, you can act as a subject, as well as other subjects with similar mechanisms for generating reality, making distinctions. At the same time, the observed phenomenon is always refracted through the prism of a person’s individual experience, and has a personality coloring. The accessibility of the environment to the cognitive experience of the subject reflects its fundamental constructibility and, as a result, causes a representation in the form of reality in the subjective world of the subject. Inaccessible (not constructed) to cognitive experience elements of reality are not perceived by the subject in the form of an environment. Accessibility to cognitive experience implies that the subject has tools to influence the environment. These tools exist in both ideal and physical form, and reflect the property of interactivity.

Extrasubject spatial localization is manifested in brain constructs separating the properties belonging to the environment from the properties of the subject. In brain constructs, the environment is always located outside the subject.

The autonomy of the existence of the environment is manifested in the presence of its own history not directly related to the experience of the subject, which appears only in the process of interaction with the environment.

The synchronization of the environment determines the presence of individual temporal qualities inherent in all elements of the environment and associated with the processes of modification of the gamer's experience.

The integrity of the environment characterizes the unity and interconnectedness of its multi-quality content of social and physical nature with the properties of the subject. It manifests itself in the constancy of the perception of a person who constructs and constitutes the environment as the world of his activity.

Motivation ability of environment characterizes the possibilities and mechanisms of influence of the environment on the motivational sphere of the subject, modulating its activity, forcing to accept the rules of behavior in the environment, forcing and encouraging, absorbing and immersing it in activity. It presents the form of the dictates of the environments. It is provided mainly by the content of the medium, the storyline and the gamer’s role-playing behavior.

Cognitive processes in the psyche of a gamer are associated with the acquisition and use of knowledge in the gaming environment. However, the concept of “knowledge” in post-non-classical ergonomics has a different meaning from the concepts of “knowledge” adopted in traditional instrumental theories:

• Knowledge, unlike information, cannot be extracted from the person in which it exists in an implicit form;
• It cannot be transferred directly from person to person. It can be built only by man, grown in it;
• Knowledge arises and develops with a person, improves in the process of life, acquires properties that take into account the experience of the subject;
• Knowledge does not possess a material form, operations similar to operations with physical, material objects are not applicable to it;
• Knowledge is related to the work of the mechanism of understanding;
• Knowledge bears the features of a social construct that reflects interpretations generated and shared by community members;
• Language acts as a means of constructing knowledge [9].

In the works of Sergeev S.F. a theory of activity in immersive environments was developed [7], which proved to be effective in creating simulators and aircraft systems with increased automation [10].

4. The problem of similarity in the game world

The accuracy of simulating an artificial game environment within the framework of a medium-oriented approach reflects its similarity to the environment of the physical world and is a characteristic of medium redundancy [11]. The richer the environment, the easier it is for the subjects of the game to find individually determined forms of behavior leading to the solution of the game problem. The saturation of the environment is manifested in the properties of the world of tasks that arise before the actor. The larger the class of possible interactions with the gamer is provided by the medium, the wider is its potential. However, it makes no sense to seek to saturate the environment only with analogues of the elements of real activity. It is advisable to enter into it objects with properties that differ from the properties of objects of the game activity. Higher accuracy of imitation is inexpedient for technical and economic reasons.

You can apply a three-component definition of simulation accuracy in the game: the fidelity of the equipment (workplace), the fidelity of the environment, and the psychological fidelity. Equipment fidelity refers to the degree to which the game interface duplicates the appearance and dynamic properties of a certain environment and artifacts used. Here, the accuracy of modeling should be maximal (indistinguishable by the senses). Environment fidelity refers to the extent to which imitation is perceived as the real environment. Here, as we have already noted, the simulated reality must correspond to the dynamic qualities of the real environment, but its objective content can be saturated with objects of various degrees of dynamic and physical similarity, which is related to the goals of the future game activity. And, finally, the psychological similarity refers to how much the gamer perceives the artificial world and its subject filling as a copy of the real world. Psychological similarity is the concept which is driven by previous experience of the gamer. Its high accuracy at the initial stages of learning the game does not matter much. The general principle of choosing the degree of similarity of the gaming environment is that the maximum dynamic similarity is required to ensure the gamer’s motor and sensorimotor coordination in the form of artifact management skills, and the minimum is to solve problems involving the higher mental functions of the operator (in the form of knowledge and skills). At the same time, in all cases, it is useful to change the modeled parameters within the limits providing the functional reserve.

It is important to note that in the gaming environment the results of influences on her by the learner are saved, which can be interpreted in terms of behavior, solving the game problem, working out modes of operation, etc. The game control system records the results of each gamer’s activities and ranks them according to their achievements of the game goals. However, the full automation of meaningful interpretations of these processes is to a certain extent limited. The structure and capabilities of the artificial world modeled in the information-dynamic model and intersubjective communication gives rise to gaming motivation to learn. Thus, in the game, an interaction of the autopoietic systems of the gamers and game communication with the objects and subjects of the game world occurs. It is important that the games for e-sports should not include a random factor in achieving the result, which should depend only on the knowledge and skills of the gamer.

At the present stage of development of the gaming industry emergent gameplay (emergent gameplay) consists of arising in the game, not provided by the developers of forms of game behavior, non-linear narration and gamer-generated content, which allows one to generate new content directly in the game based on the gamer's activity [12].

5. Immersiveness, presence and interactivity in the game world
The main interface properties of the gaming environment are expressed in terms of immersiveness, presence, interactivity [13]. Immersiveness is a property of the gaming environment, showing its ability to involve the subject in the current system of relations, determined by the content of the environment. Immersiveness can be defined as the properties of technological part of the gaming environment, providing the psychological state of a person in which his “I” perceives himself shrouded, turned on, and interacting with a certain environment, providing him with a continuous stream of incentives and experience. This is a dialog experience and the gamer, in turn, can also be included in the gaming environment, using internal mechanisms for immersion. A game can be considered as an immersion in dialog experience produced by an artificial (or natural) gaming environment. The ability to play is connected with the gamer’s ability to immerse himself in the game plot, the game environment and act in it, having rebuilt from the surrounding distracting and interfering influences.

Immersiveness is associated with the depth and breadth of the content of the environment. The depth depends on the amount of data encoded and transmitted in a separate communication channel formed in the medium, and the “width of information” determines the number of sensory measurements presented simultaneously. The breadth of information is achieved through polymodal forms of information. A high degree of immersiveness of the game can be achieved in various ways, including: the use of virtual reality systems, immersion into the world of the game scenario, instructions and algorithms of behavior in the game [14]. As a result of immersion in the environment, the subject of the gaming experience has a sense of presence.

Presence expresses the feeling of being in a certain environment, including one that is different from the environment of direct sensory experience. The difference between immersiveness and presence is that the first concept is more connected with the technological, physical and narrative characteristics of the gaming environment, and the second defines the subjective components of the environmental experience. The experience of presence can occur not only in physical environments, but also, for example, in the process of reading a literary work, but the author of the work must be provided with the immersiveness of the environment in which the plot unfolds. Books are still an effective means of creating artificial worlds, allowing readers to experience what is happening in them, like what is happening in the real world.

Presence, despite its external terminological simplicity, is a complex concept associated with various aspects of a person’s relationship with the environment(s). In the works of C. Heeter, three different types of presence were distinguished: ecological, social, and personal [15]. Ecological presence shows the degree to which the environment itself seems to recognize your existence and respond to you. Many environments formed by virtual reality systems are indifferent to users. Social presence means that if a lot of people are immersed in a virtual environment, the presence of others provides additional evidence that the environment “exists”, and thus each participant experiences higher levels of presence. Most gamers of online computer games and chats are strongly attracted to social interaction in these environments. Personal presence is a measure of the degree to which and for what reasons everyone feels to be "in" a virtual environment. Six types of presence are identified in studies of M. Lombard and T. Ditton:

- Presence as social wealth. This is the degree to which the environment is perceived as helping to communicate when interacting with other people, warm, sensitive to the personnel using it;
- Realism is the extent to which the environment may seem perceptual and/or socially realistic to the observer;
- Transportation is your sense of “being there”, “here” and/or “together”;
- Immersiveness is the degree to which a person’s sense organs are occupied by his environment;
- Social actor within the environment is the extent to which the user responds socially to the person’s representation through the environment;
- Environment as a social actor is the extent to which the environment itself is perceived as a social actor [16].

The presence associated with virtual reality is most often considered in accordance with the concept of “presence as transportation”. At the same time, people are usually considered to be in an immersive
virtual reality in the case when they communicate about their feelings of being in the virtual world (“You are there”). The term presence in the company of people or “social presence” shows the feeling of being together in the virtual world (“we are together”).

D.W. Schloerb distinguishes two types of presence:

- Subjective presence is associated with the person's judgment that he is physically located in a real, remote, or virtual environment;
- Objective presence, probability of successful completion of the task [17].

Schloerb’s definitions of subjective and objective presence are fully empirical. Questioned is the value of subjective presence. Objective presence, ability to work, should be the most important criteria for virtual reality.

An important distinction between “presence” and “immersiveness” is suggested by Slater M. & Wilbur S.:

- Immersiveness is an objective description of aspects of the system, type of representation field and visualization technologies;
- Presence is a subjective phenomenon such as the feeling of being in a virtual environment [18].

Schubert et al. propose an embodied structure of knowledge as a means to explain presence [19]. The mental representation of the environment is made in terms of patterns of possible actions based on perception and memory: “Presence is experienced when these actions involve a perceived ability to conduct and move one’s own body in virtual reality (VR).” In predicting the outcome of actions, people have the ability to suppress the contributions of the current environment, which explains why we can experience a presence in VR, despite the sense of the conflicting characteristics of the real environment.

Presence in the game world can be considered as one of the criteria for the incarnation of the gamer's “I” in the “I” of an effective game character.

Opportunities for gamer activity in the environment are provided by its interactivity showing up to which extent users can participate in changing and shaping the content of an established environment in real time. Interactivity is the user's power to manage changes to a given environment. In this case, the virtual world must respond to the actions of the gamer. Interactivity requires dynamic modeling and is determined by the technological structure of the gaming environment, the properties of its interface. Interactivity reflects the compliance of the form of the medium and its content to the gamer’s actions.

The degree of interactivity depends on many factors, which include:

- The speed with which the system handles normally and the speed of assimilation of input effects in the environment;
- Range is the number of opportunities for action at any given time;
- Mapping is the ability of a system to control changes in an artificial environment in a natural and predictable form [20].

Examples of the interface through which interactivity is realized in computer gaming environments are the keyboard, mouse, gloves, tablets, speech recognition systems, gaze directions, virtual reality helmets with induced media, etc.

6. Conclusion

Creating efficient gaming environments which provide competitive cybersports requires a serious attitude to the processes of self-organization in the gamer's psyche embodied in a game character immersed in the game world and interacting with the game environment. Integration of all aspects of the game is possible with the use of methods and ideas of non-classical ergonomics of immersive environments, allowing one to take into account the self-organizing nature of the psyche of the gamer involved in game communication.

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