References

- training of a new generation of specialists in the field of Artificial Intelligence, who are initially focused on convergence, on ensuring compatibility of their results with the results of their colleagues and on the specification of their results within the Library of standard (reusable) components;
- permanent development of the *OSTIS Technology Standard*, presented in the form of a <u>formalized</u> text of the *knowledge base* of the Meta-system for supporting the design of *intelligent computer systems* developed using *OSTIS Technology*.

VI. FEATURES, ADVANTAGES AND NOVELTY OF OSTIS TECHNOLOGY

The novelty of *OSTIS Technology* primarily consists of:

- the requirements for systems created and maintained with the help of this Technology (for *next-generation intelligent computer systems*) – hybridity, interoper-ability, self-learning

- the requirements for the *OSTIS Technology* itself (for the methods used by it, automated methods and tools) – the complexity of the technology, its versatility and self-learning

Additional factors of the novelty of *OSTIS Technology* are:

- the fact that the intensive evolution of the *OSTIS Technology* itself (the transition to its new versions) does not lead to the moral aging of already operated *intelligent computer systems (ostis-systems)*, since during the operation of these systems, their automatic modification (modernization) is possible in the direction of bringing them into line with the current version of the *OSTIS Technology*;

- the fact that permanent support of semantic compatibility of operated *intelligent computer systems (ostis-systems)* is provided during their own evolution, as well as during the evolution of the *OSTIS Technology* itself;

- the fact that the basis of the activity (functioning) of hierarchical collectives of *ostis-systems* is <u>decentralized</u> planning, initiation and situational management of collectively performed actions (processes) carried out within the framework of both long-term and temporarily existing *collectives of ostis-systems*;

- in a significant increase in the efficiency of expanding and using the Library of standard (reusable) components of ostis-systems (*OSTIS Libraries*) due to:

  - exclusion of semantic equivalence of components;
  - a significant reduction in the variety of logically and functionally equivalent components;
  - the presence of a simple and fairly easily automated procedure for integrating the components of the specified library and, accordingly, the procedure for assembling *ostis-systems* from ready-made components of the *OSTIS Libraries*

- in the orientation to create an <u>integrated</u> model that ensures the <u>coordination</u> of the entire variety of types and areas of *human activity* and to develop the architecture of a global complex of *ostis-systems* that provides automation of this diversity (*OSTIS Ecosystem*)

VII. CURRENT PROJECTS OF THE CURRENT STAGE OF WORK ON THE DEVELOPMENT OF OSTIS TECHNOLOGY

Let's list some projects of applied *next-generation intelligent computer systems* that are relevant at this stage and the means of their development:

- Development of a formalized **Standard for next-generation intelligent computer systems**, presented as part of the *knowledge base* of the intellectual portal of scientific and technical knowledge on the theory of *next-generation intelligent computer systems* and providing *semantic compatibility of computer systems* of this class [11].

- Development of a formalized **Standard of methods and tools for supporting the life cycle of next-generation intelligent computer systems**, presented as part of the *knowledge base* of the intelligent *Metasystem for automating the life cycle of next-generation computer systems* (*OSTIS Metasystem*)

- Within the framework of the **OSTIS Metasystem**, providing <u>wide</u> access to the current state of the *OSTIS Standard* and developing appropriate semantic visualization and navigation tools.

- Within the framework of the **OSTIS Metasystem**, the development of automation and management tools for the process of collective improvement (modernization, reengineering) of the *OSTIS Standard*.

1

- Development of a **software platform** for the implementation of *next-generation intelligent computer systems.*

- Development of an **associative semantic computer** for the implementation of *next-generation intelligent computer systems.* This is a <u>universal</u> computer in which the hardware implementation of associative reconfigurable (structurally tunable) memory is carried out, in which information processing is reduced to reconfiguration of connections between memory elements.

- Development of the architecture of the *next-generation intelligent computer system*, which is a **personal intellectual assistant** (secretary, referent) for each user, providing the maximum possible automation of the user interaction process with the entire Global ecosystem ofnext-generation intelligent computer systems (OSTIS Ecosystem). The knowledge base of each such personal intellectual assistant includes:

  - personal information of the corresponding user, access to which is provided to other *intelligent computer systems* by the personal intelligent assistant of this user, but necessarily with the permission of this user and with the notification of the relevant risk factors to the user. The user's personal information is his medical data, biographical data, personal photographs, unpublished intellectual property, generated or sent messages addressed to other users or various communities.

  - information about various communities of the *Global Ecosystem of next-generation intelligent computer systems*, of which the corresponding (assisted) user is a member, indicating the role (position, duties) that the specified user performs within each such community. There can be many of these communities — professional communities, friends, relatives, consumer-producer communities, administrative and civil communities, banks, medical service communities, etc.

  - information about your own plans and intentions (both strategic and immediate, including meetings, negotiations, meetings)

  Personal intelligent assistant problem solver

  - provides the maximum possible automation of various types of professional <u>individual</u> activities of the corresponding (serviced) user;

  - provides intellectual mediation (representation of interests) of the served user within all communities of which he is a member.

  User interface of a personal intelligent assistant

  - provides the user with the means to manage his <u>individual</u> activities carried out <u>collectively</u> with the corresponding personal <u>intellectual</u> assistant;

  - provides a <u>unified</u> nature of user interaction within the various communities to which it belongs. The simplest type of community is a one-time dialogue between two users.

- Development of a unified **set of automation tools for individual design of fragments of knowledge bases**, which is part of each user's *personal intellectual assistant* and provides support for individual contributions to the development of both their own (personal) *knowledge base* and the *knowledge base* of other systems that are part of the *Ecosystem of intelligent computer systems.* The specified complex of automation tools includes

  - editor of the internal representation of knowledge (*editor of sc-texts*);

  - editors of various external forms of knowledge representation (*sc.g-texts, sc.n-texts*);

  - translators from the internal representation of knowledge to various external forms of representation;

  - translators from each form of external representation of knowledge to their internal representation;

  - means of syntactic and semantic analysis of the projected fragment of the *knowledge base*;

  - a translator that provides the transformation of the internal representation of knowledge (in *SC-code*) into a natural language representation in the format of the LaTeX markup language that meets the requirements for the design of articles in collections of scientific and technical materials. This translator will allow to concentrate the efforts of developers of various *intelligent computer systems* on the formalization of scientific and technical knowledge used in intelligent computer systems, and significantly reduce the complexity of the preparation and registration of publications of relevant scientific and technical results. In the future, various scientific and technical journals should be transformed into intellectual portals of collectively developed scientific and technical knowledge in various fields.

- Development of a set of textbf*tools* for *individual comprehensive permanent medical control and monitoring* of the corresponding (serviced) user within the framework of a personal intelligent assistant

- Development for each community of *next-generation intelligent computer systems* of a unified set of

tools for the collective development of a common knowledge base of this community (*knowledge base* of the corporate system of the specified community), which includes:

- means of assembly (integration) of the developed *knowledge base* from its individually developed fragments;

- means of coordination of individually developed fragments (personal points of view, the epicenter of which is the coordination of the *concepts* used);

- means of mutual reviewing;

- means of coordinated adjustment of the *knowledge base*;

- means of forming and agreeing on a plan for improving a collectively developed *knowledge base*;

- means of monitoring and managing the process of improving the collectively developed *knowledge base*.

- Expansion of the set of **design automation tools** for various types of components of *next-generation intelligent computer systems (ostis-systems)* and various classes of such systems.

- Development of the formal structure of the global complex of automated human activity and the corresponding architecture of the **OSTIS Ecosystem**. A significant expansion of the areas of application of *OSTIS Technology* (medicine, industry, construction, law, and so on).

- Development within the framework of the *OSTIS Ecosystem* of a **set of tools and techniques for training specialists in the field of Artificial intelligence** (at the level of students, undergraduates and postgraduates).

- Development within the framework of the *OSTIS Ecosystem* of a **complex of means of informatization of secondary education** with the help of semantically compatible *next-generation intelligent computer systems.*

- Development within the framework of the *OSTIS Ecosystem* of a **complex of informatization tools for higher technical education** using semantically compatible *next-generation intelligent computer systems.*

ACKNOWLEDGMENT

REFERENCES

[1] A. V. Palagin, "Problemy transdisciplinarnosti i rol' informatiki[problems of transdisciplinarity and the role of informatics]," Cybernetics and System Analysis, no. 5, pp. 3–13, 2013.

[2] A. Kleshchev, V. Gribova, D. Krylov, F. Moskalenko, S. Smagin, V. Timchenko, M. Tyutyunnik, and E. Shalfeeva, "Oblachnaya platforma dlya razrabotki i upravleniya intellektual'nimi sistemami[cloud platform for development and management of intelligent systems]," in Proceedings of the I International Scientific and Technical Conference, 10-12 February, Minsk, 2011, pp. 5–14.

[3] V. Golenkov, N. Gulyakina, I. Davydenko, and D. Shunkevich, "Semanticheskie technologii proektirovaniya intellektual'nix sistem i semanticheskie associativnie computeri[semantic technologies of intelligent systems design and semantic associative computers]," Reports of Belarusian State University of Informatics and Radioelectronics. 2019, no. 3, pp. 42–50, 2019.

[4] G. Shchedrovitsy, "Ishodnie predstavleniya i categorizacionnie sredstva teorii deyatel'nosti[initial representations and categorization means of activity theory]," Selected works, pp. 232–298, 1995.

[5] I. Lukashevich, R. Machinskaya, and M. Fishman, "Structurnaya organizaciya medicinskoj informacii "eeg-expert"[structural organization of medical information "eeg-expert"]," "Mathematical methods in engineering and technology"MMTT-2000, 2000.

[6] N. Borgest, "Startegii intellekta i ego ontologii: popitka razobratsya[strategies of intellect and its ontology: an attempt to understand]," Design Ontology, no. 9, pp. 407–425, 2019.

[7] S. Bhatt, C. Zhao, A. Seth, and V. Shalin, "Graph znanij kak sredstvo ulucheniya ii[knowledge graphs as a means to improve ai]," Open Systems, 2020.

[8] V. Tarasov, Ot mnogoagentnykh sistem k intellektual'nym organizatsiyam [From multi-agent systems to intelligent organizations]. M.: Editorial URSS, 2002, (in Russian).

[9] R. Gataullin, A. Gatiatullin, R. Gilmullin, O. Nevzorova, D. Mukhamedshin, D. Suleimanov, B. Khakimov, and A. Khusainov, Formal'nie modeli i programmie instrumenti comp'uternoj obrabotki tatarskogo yazika: Nauchnoe izdanie [Formal models and software tools for computer processing of Tatar language: Scientific publication]. Kazan: Publishing house of the Academy of Sciences of the Republic of Tatarstan: Academy of Sciences of the Republic of Tatarstan, Institute of Applied Semiotics., 2019.

[10] D. Muromtsev, D. Volchek, and A. Romanov, "Industrial'nie graphi znanij - intellektual'noe yadro

cifrovoj economiki[industrial knowledge graphs - the intellectual core of the digital economy]," Control Engineering Russia, 2019.

[11] V. V. Golenkov, N. A. Gulyakina, and D. V. Shunkevich, Otkritaya technologiya ontologicheskogo proektirovaniya, proizvodstva i ekspluatacii semanticheski sovmestimix gibridnix intellektual'nix comp'uternix sistem[Open technology of ontological design, production and operation of semantically compatible hybrid intelligent computer systems]. Minsk: Bestprint, 2021.

Основные направления, проблемы и перспективы развития интеллектуальных компьютерных систем нового поколения и соответствующей им технологии

Голенков В. В., Гулякина Н. А.

В статье рассмотрены основные направления, проблемы и перспективы развития интеллектуальных компьютерных систем нового поколения и соответствующих технологий с акцентом на современное состояние работ в области Искусственного интеллекта. Освещены проблемы и методологические вызовы современного этапа развития, а также предпосылки перехода к интеллектуальным компьютерным системам нового поколения. В тексте также представлены предыстория и история развития Технологии OSTIS, а также описаны ее особенности, преимущества и новизна. Дополнительно упоминаются текущие проекты, связанные с развитием Технологии OSTIS на текущем этапе работы.