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Abstract	The choice of this topic is determined by the importance of the intellectualization of agriculture in the current conditions. “Agrocyborg” is a scientific term, which meaning is formed at the junction of biological-technical and cultural-philosophical concepts of building and functioning of a biomach system. In the original version, agrocyborg is an agricultural worker, a bearer of soil traditions, and, due to symbiosis with high-tech tools, is also an electronic personality, a representative of eHomo, an electronic human. In various conditions of ascribing vital, mental and personal private phenomena to the biomach of the agro-industrial complex (AIC), the cyborg self appears in the guise of a human cyborg, an animal cyborg and a plant cyborg. The agrocyborg project is included in the methodology for building and applying biomach systems and is funded by the triad “human-machine-living”. The authors suggest specific ways of constructing and using agrocyborg in animal husbandry and crop production. This allows highlighting the unsolvable, i.e., philosophical aspects of agrocyborg project, including the problems of causal informational interactions of bio- and techno-subsystems; of trusted attribution of cognitive phenomena to various classes of agrocyborgs; and of interdisciplinary coordination.

Keywords (separated by '-')	Cyborg - Agrocyborg - Self-agrocyborg - Agrocyborg-human - Agrocyborg-animal - Agrocyborg-plant - Agro-industrial complex - Biomach system

Author Proof

General Methodological Issues of Agrocyborgs: (From Human to Plant)

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Abstract. The choice of this topic is determined by the importance of the intellectualization of agriculture in the current conditions. "Agrocyborg" is a scientific term, which meaning is formed at the junction of biological-technical and cultural-philosophical concepts of building and functioning of a biomach system. In the original version, agrocyborg is an agricultural worker, a bearer of soil traditions, and, due to symbiosis with high-tech tools, is also an electronic personality, a representative of eHomo, an electronic human. In various conditions of ascribing vital, mental and personal private phenomena to the biomach of the agro-industrial complex (AIC), the cyborg self appears in the guise of a human cyborg, an animal cyborg and a plant cyborg. The agrocyborg project is included in the methodology for building and applying biomach systems and is funded by the triad "human-machine-living". The authors suggest specific ways of constructing and using agrocyborg in animal husbandry and crop production. This allows highlighting the unsolvable, i.e., philosophical aspects of agrocyborg project, including the problems of causal informational interactions of bio- and techno-subsystems; of trusted attribution of cognitive phenomena to various classes of agrocyborgs; and of interdisciplinary coordination.

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1 Introduction

The purpose of this work is to conceptualize the concept of an agrocyborg as a promising project of the AIC. Agrocyborg embodies the socio-humanitarian values of the traditional peasant and the physical abilities of a human, greatly enhanced by technology. In existing studies, this term is widely interpreted [1–4]. The article attempts to expand the understanding of agrocyborg as a biomach system of human, animal and plant types. The paper attempts to create a common methodological and technological basis for standardization and unification of various acrocyborg projects.

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A number of agrocyborg projects is briefly considered. The Self-agrocyborg seems to be the most basic version of this project, because it allows to confidently connect the causal relationships of private cognitive phenomena with the functions of attached technical means. How, for example, does a shovel become my technically extended hand, acquiring the status of an object of my subjective reality? Confidential attribution of cognitive phenomena to other agrocyborgs-humans is carried out due to assessment of cognitive functions of Self-agrocyborg. The cognitive architectonics of agrocyborg-animal is even more hypothetical from the standpoint of reliably attributing real mental functions of animals to it. However, it is quite acceptable to extend the behaviorist methodology to virtual reality of the "as it were mental life" of an animal. For example, a cow with technical means of milking is considered. Even more problematic is the "as if mental life" of the plant. However, technical extensions are also possible for this version of the project, for example, in the form of an "electronic nose" that regulates the vital functions of plants. The methodological invariant for the indicated classes of agrocyborgs is considered in the theory of the biomach system and its applications.

2 Biomach Systems in the Context of the Functional Systems Theory

There are dozens of definitions for a system and a systematic approach. In our opinion, the most profound approach is the theory of functional systems developed by P.K. Anokhin and his school [5]. For the AIC, an adequate systematic approach is set by the theory of biomach systems, within which the mathematical foundations for the construction and application of biomach systems were developed within the framework of the categorical theory of systems: functional, relational, ergatic, and other types [6, 7]. In the theory of biomach system as a categorical theory of systems, the main factor is the system-forming factor that provides a holistic coverage of subsystems and elements and their constructive formation, which includes the production of all types of agricultural products, including food of animal and vegetable origin. A biomach system necessarily includes a productive living (plants, animals, biomasses). It turns out the conceptual triad "human-machine-living". The implemented technologies with AI directly affect the productive life. At least two positions should be reflected here: 1) specific patterns of systems functioning with a productive living, which are not in purely social, human-machine, socio-technical and other systems - the listed ones are too general for our purposes, they do not have an "agro-component"; 2) development of the concept of trust in these specific technologies with AI. It should be noted the applied AI technologies used in the AIC for the needs of animal husbandry and crop production, farm management, logistics and marketing. These include remote control using satellites, drones and sensors; big data collection and analysis tools; robotization; internet of things [8, 9]. As an illustrative example, let's take the products of the American company Carbon Robotics, which has released a series of farming robots that destroy weeds without harming the soil. One such robot, using the thermal energy of a laser, can destroy 100,000 weeds in an hour [10]. However, in the light of such a large-scale challenge, changing the agricultural system and becoming it in accordance with the logic of a smart factory based on the introduction of the technologies indicated above does not qualitatively distinguish the AIC from conventional production and is not enough to provide an effective basis for a breakthrough digital transformation of the economy [1]. The second important difference is the presence of solvers with elements of artificial intelligence in biomach system. The aforementioned is directly reflected in the scheme of the biomach system.

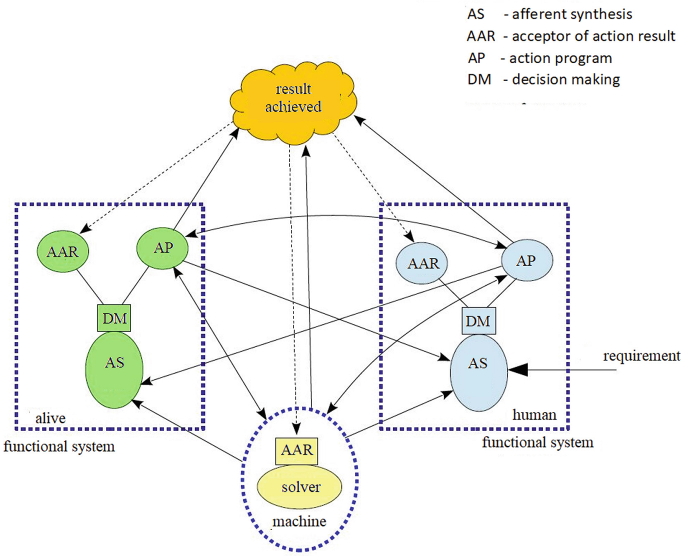

Fig. 1. Schematic diagram of biomach system

Solvers are built into the machine block of the biomach system (see Fig. 1), allowing the development of new algorithms for the machine's behavior, which are not included in it in advance by the designer (programmer). The demand for the inclusion of these components with solvers and productive living things in the agrarian system is updated by and large with the beginning and expanding in the AIC, the transition in technologies from average statistical criteria to the individual operation of machines with individual elements of living, in particular, individual animals and plants in precision farming, etc. Agrocyborg due to this model gets the following capacities:

1) to monitor in constant interaction with drones the state of the economy and collect data for subsequent analysis and prevent emergencies;
2) to participate directly in the processing and analysis of data within the framework of predictive analytics;
3) to get more qualitatively involved in "precision farming", the result of which is a multiple increase in yields [11];
4) to become a full-fledged participant in the marketplace (platform, ecosystem) for the sale and delivery of products to consumers for the purchase and sale of equipment and machinery with a break in the chain of intermediaries and their exclusion [5];
5) to ensure the breakthrough development of agricultural production with special regard for reserves, the assessment and justification [6];

6) to be a tool to achieve productive living conditions for the realization of the genetic potential laid down by breeders.

When designing agricultural machines and mechanisms, it is advisable to refer to the theory of the genome and to the methods of algebraic biology, as indicated in the diagram (Fig. 2).

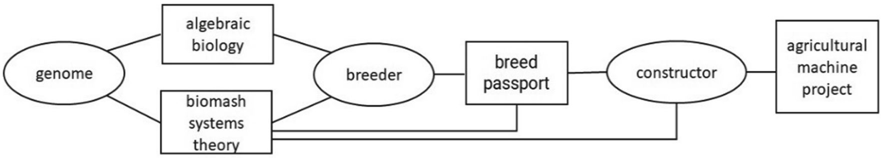

Fig. 2. Scheme from genome to agricultural machine project

In addition to such genetic foundation, the biomach system becomes a full-fledged agricultural machine when combined with plows, seeders, sprayers and other units for direct work with a productive living being. An example is sprayers operating on the principles of the "electronic nose" technology, which makes it possible to capture specific volatile substances emitted by individual plants in the event of a whitefly attack, process information and subsequently act on individual plants (insects located on them, distribution areas, etc.) to improving the health of plants. The electronic nose also successfully "sniffs out" tomato aphids, harmful insects of other crops. The information received from plants allows to pass from average spraying treatment to targeted treatment[12]. This saves the cost of the solution and prevents excessive soil contamination.

3 Agrocyborg Neural Interfaces and Chipization

As we noted above, the concept of cyborg has been actively used in scientific and mass discourse in recent decades. Cyborgization is a process of merging the bodily with the technological, combining the natural with the artificial. This is the convergence of the human and biological with the technological, the result of which already has a new nature, where the unity of consciousness with the body is supplemented by another component of this "trinity" - computer technology, which in turn supports three-dimensional (3D) semantics, linking a private cognitive phenomenon, a scientific description or an explanation of this phenomenon and a computer implementation of the phenomenon as an imitation, model or reproduction [5]. The concept of cyborg in the public sphere refers to people with artificial parts embedded (implanted) in them: dentures, pacemakers, heart valves, artificial kidneys, limb prostheses, exoskeletons and other mechanical and electronic implants built into the body. Since the last century, implants that are directly interfaced with the nervous system have been mostly common. The signals from the electrodes are amplified by the outer hair cells of the organ of Corti, transferred to the inner hair cells, from which, based on the sodium-potassium mechanism in the dendrites of the auditory nerve, action potentials are excited that propagate to the auditory part of the brain, where they are recognized [1].

The next level of cyborgization corresponds to invasive contact directly with brain neurons. In medicine (in connection with the treatment of epilepsy, Parkinson's disease, and other diseases), the technology of craniotomy has been developed; it is used for implanting an electrode grid, strip, or deep electrodes into the exposed surface of the cerebral cortex. In electrocorticography (ECoG), grids are used, as well as strips of round (plate) electrodes placed on the surface of one hemisphere. Electrode grids usually contain many current-collecting contacts that record impulses from a large surface area of the cerebral cortex. In stereotaxic EEG (SEEG), cylindrical electrodes are used, having up to a dozen current-collecting surfaces and penetrating through the skin, skull and all membranes of the brain to subcortical structures. This method provides monitoring of superficial and deep cortical structures [13]. As a result, direct neuronal electrocorticographic brain-computer interfaces arise, which, by picking up signals from brain neurons, provide control of electronic prosthetic and communication devices. They provide great opportunities for restoring functions lost due to neurological disorders in humans. In particular, ECoG signals recorded from the cerebral cortex are used as control signals for external devices (prostheses for paralysis, etc.). Work is underway to decode signals for imaginary speech, music, etc. [14]. The next stage of cyborgization technologies is the direction of the input signal to the cerebral cortex using ECoG electrodes for direct electrical stimulation. Electrical stimulation and simultaneous ECoG recording establish a bidirectional brain-computer interface. It becomes possible to control cyborgs and organize their interaction through direct neural interface communication, which may also exclude traditional sense organs.

In the Russian Federation, the "pilot" mass chipization began in 2019: ten volunteers from Tomsk State University implemented chip providing functions of a bank card, an electronic key for access to the facilities of the University, a transport card, etc.) [16]. Abroad, human chipping began in 1998 with the experiment of K. Warwick, who implanted an RFID implant under the skin - an implant with radio frequency identification. The chip allowed opening doors, turning on the light and giving voice commands [14]. The Swedish company Epicenter produces NFC chips implanted under the skin with covid-passports, NFC allows you to read data using a smartphone (the chip contains not only vaccination data, but also other documents). Tens of thousands of Swedes have implanted NFC to date [17]. From the simplest chips for reading information, a transition is already being made to the massive implantation of chips in the brain to pick up neuron signals and influence them. The technologies developed by I. Musk (Woke Studio), which use some versions of the ECoG and SEEG discussed above, are in the lead here. The chip size is 23 by 8 mm; it is implanted under the scalp and connected to the brain through holes in the skull with the thinnest filament electrodes [18]. A robot surgeon has been developed to implant the chip, the implantation operation under local anesthesia takes about an hour, and the client leaves the medical facility after the procedure on the same day [15].

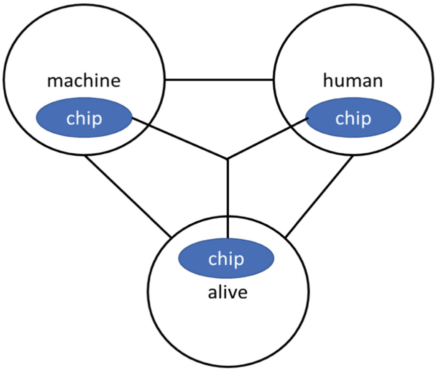

Fig. 3. Diagram of agrocyborg as a biomach system

4 Types of Agrocyborgs

The concept of agrocyborg, as noted above, is also the subject of philosophical research, shown in Fig. 3. It is unlikely that traditional questions of searching for causal relationships "psyche-brain" in the speculations of idealism, materialism, dualism, panpsychism, epiphenomenalism, etc., will be productive for cyborg building. These questions have a metaphysical status. Such a general conceptual format of the agrocyborg family is set by the functionalism paradigm of general artificial intelligence [19]. General artificial intelligence is a direction of scientific-theoretical and engineering-technological research focused on the construction and application of computer simulations, models and reproductions of cognitive phenomena of the widest range of life, mental, personal and social manifestations. In the formation of general functionalism, collective, definitive and observational approaches are distinguished. The collective approach is the collection, identification, coordination, formalization, systematization, unification, codification of all kinds of functionalist theories. The determinative approach is the analysis and identification of the main functionalist characteristics, relationships, patterns, causalities that are invariant with respect to the content of cognitive phenomena. The observational approach allows us to evaluate from the position of a human or a social community, immersed in the communicative "waves" of the virtual and real world, the various statuses of technological implementations of general functionalism. And paying tribute to the theory of systems, the role of a system-forming factor in the family of agrocyborgs with their various functions, characteristics and abilities, is Self-agrocyborg.

Self-agrocyborg: The concept of a human cyborg was voiced by L.V. Poskotinova (D.B.S., Ph.D.) in 2018. According to the speaker, the intellectualization of neurobiotechnologies contributes to software and hardware implementation of biofeedback by modeling the functions of the central nervous system, higher mental functions and the functions of visceral systems (cardiovascular, respiratory, gastroenteric and etc.). The praxeological question is valid. How ready is human to trust a machine to broadcast his own bodily, visceral sensations? If the machine is used only as a recording device, then human can trust the machine and follow the indicators that it presents to a human. But if the machine has its own goals for using human health indicators, then human risks receiving false feedback from indicators that may be far from his own. The question arises of testing equipment used for biofeedback for AI. At the heart of the methodology of such testing, it is preferable to combine the principles of introspection and self-examination (for example, analysis of frequency, rhythm, and fullness of the pulse). The Comprehensive Turing test [20] contains several introspective tests. They connect the phenomena of subjective reality, studied by the subject of this reality, with the results of computer simulation of these phenomena. The neurovisceral test concretizes these abstract tests in relation to the most important area, more important than the human mind - his health. There are about a hundred major versions of Turing test. Among them, Poskotinova's neurovisceral test seems to be very original and significant [21]. Self-cyborg is formed as follows. A comprehensive Turing test is being studied to select the necessary cognitive-computer competencies [20]. These competencies are formed from a list of values of a definite function: can the biomach system communicate; think; reason reasonably; function like a mentally healthy individual; understand; have a subconscious experience emotion, attribute mentality; create; self-formalize; self-organize; be indistinguishable from a human, but also not be a zombie; to have a different (foreign) consciousness; process ideas. In other words, can a biomach system do everything? This is what private Turing tests suit for.

Agrocyborg–Human (Not-self, Other, Alien): This is a biomach system, to which I attribute cognitive functions by analogy with my cognitive functions, and a cyborg, to which I attribute cognitive states and the content of these states, by analogy with my cognitive states and the content of these states. Since we have adopted the concept of general AI functionalism, which is based on the machine functionalism of H. Putnam, then all the arguments and objections to attributing my cognitive functions are fully consistent with the intersubjective methodology: to perceive the pain of another means to be in the same state of pain in which I find myself I am in conditions of certain pain stimulation and reactions, as well as an appropriate program of action with my biomach.

Attributing cognitive phenomena to an animal is much more problematic than the case of attributing them to another human. There are conflicting views on the attribution of cognitive phenomena to animals presented in the format of robots. Thus, J. Searle believes that "humans naturally attribute intentionality, for example, to primates or domestic animals, respectively, to monkeys or dogs. Roughly speaking, there are two reasons for this: without such an attribution, it is impossible to understand the intentions of animals, and it is obvious that animals are somewhat similar to humans (this is their eye, this is their nose, but this is skin, etc.). The coherence of animal behavior to human behavior, as well as the belief in the unity of nature, are justifications for a number of assumptions: the presence of mental states in animals; conditioning their behavior; producing the mental states of animals by the same mechanisms that generate the mental states of humans. Similar assumptions apply to the robot. However, we do not recognize them, because we know that the robot's behavior is the result of the work of a formal program and that the robot does not have that physical substance, on the basis of which real causal dependencies are generated. Therefore, the robot should be denied intentionality" [18]. Another cognitive philosopher, A. Solman, thinks differently. In the light of the analysis of the intersubjective phenomena of projective consciousness, he asks: "What is it like to be a stone, a sunflower, a bat, a human baby, an Alzheimer's patient, a down, a blind man, a female (for a male), a male (for a female)?" [22]. Let us emphasize that such questions directly correspond to the theme of attributing cognitive phenomena to Self-agrocyborg, agrocyborg-Other, agrocyborg-plant. In answering any of these questions, an incredible array of epistemological problems arises. And the general answer to the question "What is it like to be X?" the answer will be "I don't know". But to answer the question "What is it like to be a robot?" it is not difficult for a robot developer: with a completely known functional organization of the robot, what will happen to the robot in such and such conditions is known. But the developer thoroughly knows not only stimuli and reactions. After all, he is fully aware of the internal states of the robot: information structure, semantics, transformations, and ways of using elements [22]. Therefore, the answer to the question of what it is like to be a cyborg-animal or a cyborg-plant is very transparent: it is thoroughly known what it is like to be.

Agrocyborg-Animal (Agrocyborg Cow): This is a "milker-cow-milking machine" biomach system developed at VIM [23, 24]. For specialists, the problems with mastitis of cows milked by common milking machines are well known. One of the disadvantages of milking, which provokes mastitis, is that the vacuum of the milking machine acts on all parts of the udder, it does not take into account that in different parts the return of milk stops at different times. Consideration of physiology shows that the commonly used methods of milking using traditional milking machines based on average statistical data on animals are very far from the process of giving milk to the calf established by nature. This is influenced by both smells and sounds and functional systems formed in the body of a cow in the process of bearing a fetus. The number of hormones alone involved in the process of milk ejection reaches almost two dozen, among the hormones, oxytocin is the main one. According to the theory of lactation, as a result of mechanical and thermal effects on the udder receptors, nerve excitations occur that reach the spinal cord and pituitary gland, which releases oxytocin into the blood. The necessary concentration of oxytocin in the blood for milk flow lasts from 2 to 5 min. The destruction of oxytocin is accompanied by the cessation of the milk ejection reflex. One of the objectives of the milking agrocyborg is thus to maintain an appropriate level of oxytocin concentration in the animal's blood for milking. This requires an oxytocin sensor and a mechanism for influencing the cow's body. The sensor has not yet been developed, so concentration is determined by indirect signs, but stimulation, including the release of oxytocin, is carried out by the device developed at VIM (resonant frequency generator - RFG, see patent [25]). A special applicator has been developed for the cow to wear the RFG; if necessary, it is possible to pair the RFG with sensors and chips implanted with the cow. Traditional machine milking is perceived by animals as a stress factor, while the physiological reaction of the animal leads to an increased release of leukocytes, which are the main mass of somatic cells in milk, which worsens its quality. The specified mode of RFG allows reducing the release of leukocytes, which has a significant effect on improving the quality of milk. Agrocyborg-cow with RFG also mastered the function of suppressing the pathogens of the above-mentioned mastitis, which is already successfully used for the treatment and prevention of this disease [23–25].

Agrocyborg-plant: Agrocyborg plants as a living component in biomach system are also necessary and promising. In recent years, the concept of plants as intelligent biosystems has been developing. Unlike animals, the system properties of plants have not been sufficiently studied; in particular, the development of the theory of plant functional systems is just beginning [3]. Action potentials were found in plants (similar to electrical nerve signals in animals) [26–29], analogs of the nervous system, in which action potentials serve to transfer information, a new science of plant neurobiology, plant biosemiotics, has arisen [30]. The technology of the electronic nose as a sensor of plant state parameters was discussed above, but the electrical activity of plants plays no less a role in their functioning than in animals. Thus, an agrocyborg-plant does not fundamentally differ from the examples of agrocyborg animals considered above. It is obvious, however, that the degree of adequacy of attributing quasi-mental phenomena to plants is very low.

5 Conclusion

In connection with the development of cyborgs for humans, animals and plants, biomach systems arise in which the "machine" subsystem is built into the human, animal, and plant subsystems. As a result, an agrocyborg appears as an element of the biomach system. In this context, agrocyborg is a viable concept that can be put into practice [31]. It generates new opportunities due to the achievements of technological progress in such an important area for the survival and development of human civilization as the AIC. The study presents sections of the theory of biomach systems related to the concept of agrocyborg. The paper presents a philosophical understanding of cyborgs and agrocyborgs based on the dynamic boundaries of "human/technical", which makes it possible to give the scientific content of the term "agrocyborg" both biological-technical and philosophical sounding. Results can stimulate the development of the AIC, the electronics industry, artificial intelligence and informatics, and also contribute to the formation of a promising field of interdisciplinary scientific and technical, natural sciences and socio-humanitarian research. The unification and standardization of biomach system that develops Self-, Other, animal- and plant-agrocyborgs, is effective for the methodology of test functionalism. Unlike machine functionalism, which subordinates cognitive functions to algorithms of the Turing machine, the presented approach liberates the agricultural worker. "Agrohuman" is able to solve not only narrow technological problems (like increasing animal weight and milk yield), but also philosophical questions: whether a biomach as a cognitive computer system is able to exist, progress, be creative, behave morally, make friends, etc. We assume that the presented position is promising both for further interdisciplinary research and for the formation of functional models in real conditions, when the digital transformation and intellectualization of AIC is a crucial demand [32].

References

1. Gurov, O.N., Kon'kova, T.A.: Conceptual model of an agro-industrial cyborg. Artif. Soc. **16**(3) (2021)
2. Gurov, O.N.: Conceptual model of agro-industrial cyborg. In: Hu, Z., Wang, B., Petoukhov, S., He, M. (eds.) AIPE 2021. LNDECT, vol. 119, pp. 1-13. Springer, Cham (2022). https://doi.org/10.1007/978-3-030-97064-2_1

3. Chernoivanov, V.I., Tolokonnikov, G.K., Shogenov, Yu.Kh., Dorokhov, A.S.: Biomach systems, artificial intelligence and agrocyborgs. In: Trukhachev, V.I., Didmanidze, O.N. (eds.) Readings of Academician V.N. Boltinsky. Digest of articles. M.: Izdatel'stvo «Sam poligrafist», pp. 40–46 (2022)
4. Gurov, O.N.: Boundaries of "human" and "technical" (on the example of D. Cronenberg's work): dis. candidate of philosophical sciences: 09.00.13. - Moscow, 191 p. (2022)
5. Anokhin, P.K.: Principles of systemic organization of functions, M.: Nauka, 315 p. (1973)
6. Chernoivanov, V.I.: Biomashsystems: emergence, development and prospects. Biomashsystems **1**(1), 7–58 (2017)
7. Tolokonnikov, G.K.: Informal categorical theory of systems. Biomashsystems **2**(4), 41–144 (2018)
8. Saida, A., Yadav, R.K.: Review on: analysis of an IoT based blockchain technology. Int. J. Educ. Manag. Eng. (IJEME) **12**(2), 30–37 (2022). https://doi.org/10.5815/ijeme.2022.02.0
9. Kumar, K.A., Aju, D.: An internet of thing based Agribot (IOT-Agribot) for precision agriculture and farm monitoring. Int. J. Educ. Manag. Eng. (IJEME) **10**(4), 33–39 (2020). https://doi.org/10.5815/ijeme.2020.04.04
10. Cui, S., Cao, L., Acosta, N., Zhu, H., Ling, P.P.: Development of portable e-nose system for fast diagnosis of whitefly infestation in tomato plant in greenhouse. Chemosensors **9**: 297 (2021)
11. Babatunde, G., Emmanuel, A.A., Oluwaseun, O.R., Bunmi, O.B., Precious, A.E.: Impact of climatic change on agricultural product yield using K-means and multiple linear regressions. Int. J. Educ. Manag. Eng. (IJEME) (2019). https://doi.org/10.5815/ijeme.2019.03.02
12. Alekseyev, A.Yu.: Volumetric (3D) intensional semantics of the dictionary of an artificial society. Artif. Soc. **8**(1–4) (2013)
13. Shchekut'yev, G.A.: Neuromonitoring: general principles and applied methods. In: Zhukov, P.V. (ed.) Neurophysiological Studies in the Clinic. Collection of Materials of the Conference in Memory of Prof. G.A. Shchekutev, M.: Antidor, pp. 208–216 (2001)
14. Korzinov, N.: Microchip under the skin: human tuning. Popular Mech. **4**, 148–151 (2006)
15. Awadalla, M.H.A.: Spiking neural network and bull genetic algorithm for active vibration control. IJISA **10**(2), 17–26 (2018)
16. The vice-rector of a Tomsk university implants an electronic chip in himself as part of an experiment. https://nauka.tass.ru/nauka/5977697. Accessed 10 June 2022
17. In Sweden, they began to implant chips with COVID-passports into the human body. https://rg.ru/2021/12/19/v-shvecii-nachali-vzhivliat-v-telo-cheloveka-chipy-s-kovid-pasportami.html. Accessed 10 June 2022
18. Serl' Dzh.R.: Minds, brains, programs. In: Alekseev, A.Yu. (ed.) Turing Test. Robots. Zombie. M.: MIEM, pp. 6–20 (2006)
19. Alekseyev, A.Yu.: The general functionalist concept of artificial need as the basis of general artificial intelligence. Philos. Sci. **62**(11), 111–124 (2019). https://doi.org/10.30727/0235-1188-2019-62-11-111-124
20. Alekseyev, A.Yu.: Comprehensive Turing test: philosophical-methodological and socio-cultural aspects. M.: AInteLL, 304 p. (2013)
21. Poskotinova, L.V.: Neurovisceral Turing test: the need for development, methodological aspects. In: Reports at the Seminar "Neurophilosophy". Faculty of Philosophy, Moscow State University, 5 December 2018. https://scmai.ru/2018/12/05/. Accessed 10 June 2022
22. Slomen, A.: What does it mean to be a stone? In: Alekseev, A.Yu. (ed.) Turing Test. Robots. Zombie. M.: MIEM, pp. 86–102 (2006)
23. Lyubimov, V.T., Romanov, D.V., Tsoi, Yu.A., Ziganshin, B.G., Sitdikov, F.F.: Results of application of frequency resonance therapy for treatment of cow mastitis. In: BIO Web of Conferences, vol. 17, p. 00254 (2020). https://doi.org/10.1051/bioconf/20201700254

24. Lyubimov, V.Ye., Romanov, D.V.: Technical and technological justification for solving the problem of treating mastitis in cows using frequency-resonance therapy in a dairy farm. Biomashsystems **2**(1), 225–235 (2018)
25. Patent for invention: Romanov D.V., Lyubimov V.E. Method and electromechanical device for the prevention and treatment of udder diseases, stimulation of lactation in cows, Application № 2020127061/10(047622), 12 August 2020
26. Mironova, E.A., Shogenov, Y., Moiseenkova, V., Romanovsky, Y.: Bioelectric responses of plants to the low-intensive irradiation in the visible and infrared ranges. SPIE **3732**, 349–352 (1998)
27. Opritov, V.A., Pyatigin, S.S., Retivin, V.G.: Bioelectrogenesis in higher plants. M., Nauka, 213 p. (1991)
28. Vasilyev, V.A., Garkusha, I.V., Petrov, V.A., Romanovskii, Y., Shogenov, Y.: Light induced electrical activity of green plants. Biophysics **48**(4), 662–671 (2003)
29. Zimmermann, M.: Candidates for systemic signals in higher plants and the challenge of their identification. Plant Physiol. **170**(4), 407–419 (2016)
30. Stepanov, S.A.: Nervous system of plants: hypotheses and facts. Bul. Bot.garden Sarat. State University, **15**(4), 31–56 (2017)
31. Brenner, E.D.: Plant neurobiology: an integrated view of plant signaling. Trends Plant Sci. **11**(8), 413–419 (2006)
32. Vani, P.D., Rao, K.R.: Implementation of smart agriculture using CloudIoT and its geotagging on android platform. Int. J. Eng. Manuf. (IJEM) **9**(2), 43–53 (2019). https://doi.org/10.5815/ijem.2019.02.04
33. Zaoui, F., Souissi, N.: Onto-digital: an ontology-based model for digital transformation's knowledge. Int. J. Inf. Technol. Comput. Sci. (IJITCS) **10**(12), 1–12 (2018). https://doi.org/10.5815/ijitcs.2018.12.01

AQ1

Author Queries

Chapter 27

Query Refs.	Details Required	Author's response
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