UDC 614.2; 004.58; 004.81

A.S. Tomashuk
(Ukraine)

Can the use of an artificial central nervous system model lead to the exclusion of the work of astronauts?

Briefly, the problems that astronauts face during space missions are described. Briefly, methods, as the activities of different types of subjects, in order to eliminate these problems, are described and compared. It is proposed to use a model artificial intelligence that describes the work of the human central nervous system.

Introduction.

The content of any space mission involves a high cost of resources. In addition, astronauts, who stay outside the earth's atmosphere, for some period of time, have health problems, both mental and physical [1-6]. Therefore, always, in order to conduct a successful space mission, it is important to ensure the preservation of human health at the required level; and, at best, with a minimum expenditure of resources.

The problem is to maintain the mental and physical health of astronauts, who perform their tasks in conditions that are not standard for their health.

The purpose of this work is a theoretical justification for the appropriate use of robots, including humanoid robots, whose artificial intelligence (AI) model is based on the anatomy of the central nervous system (CNS) and the neurophysiology of such a living organism as a person, for space missions.

To achieve this goal, it is necessary to solve the following tasks:

1. Search and analyze information in relation to the research problem;
2. Describe the methods, how the activities of different types of subjects, in order to eliminate this problem;
3. Make a comparison of known and proposed methods;
4. Choose the correct option from those that have been compared;
5. Discuss the results.

The scientific novelty is the comparison of methods that include knowledge from several fields of science to ensure a successful mission with minimal cost to the health of astronauts.

The practical significance is the conclusion about the appropriate application of the proposed method for practical purposes.

1. The main problem of space missions.

From the works [4-6], facts are known regarding the occurrence of disorders in the health – the activity of the central and peripheral nervous systems (NS) is harmed, of astronauts. These disorders include: emotional dysregulation, cognitive dysfunction – impaired perception, vigilance, memory and reaction time, etc., in addition, disruption of sleep and wake rhythms, changes of value in body weight, changes in the parameters of brain regions, etc.

At a low level, this is described by damage and mutation of DNA, and, as a result, changes in the values of separate parameters of gene expression, which affects the change in separate parameters of cell differentiation, which, in turn, affects a decrease in the number of contacts between cells, the transmission speed of information – substances between cells, and, subsequently, degeneration of cells and their death.

2. Known methods.

To perform a mission that takes place on a certain part of the surface and/or space of a planet that is not the planet Earth, satellite, space station or outer space, both the activity of a human and the activity of a robot, that is equipped with AI, can be involved [7, 8].

3. Purpose method.

The proposed method is the involvement in the activity of the robot, which AI describes the work, in some approximation, to the ideal one, of the human CNS, which depends on the amount of known information about CNS structure and principle work. This work is formed by the author [9, 10], and is at the stage of analysis and processing of information, that belongs to the field of medical sciences.

4. Description the qualities of the methods.

Advantages and disadvantages of subjects.

1. Astronaut (human).

Advantages:

- A process higher cognitive thinking, that describes the complete course of action from the beginning – as receiving a task, further – processing, and finally – making decisions, regardless of the amount of experience that one has, regarding the knowledge and skills that are suitable for solving this task;
- Higher mental activity, which allows you to receive, store and reproduce information, some of which describes the mental state – including pleasure, joy, sadness, etc., of a subject and/or group of subjects, for a certain period of time.

Disadvantages:

- Threat to health, up to a lethal outcome, of the subject;
- High resource costs (time, money, energy).

2. Robot (including a robot-humanoid), that is equipped with AI.

Advantages:

- The exit from the working state does not harm to the life of at least one person;
- Perfect opportunities for receiving and storing information;
- Perfect forecasting capabilities;
- Rapid adaptation to new conditions, to a greater extent, without harm to the health of the subject.

Disadvantages:

- The impossibility of conducting communication between subjects – for example, between a machine and a human, at the same level;

- Imperfect activity – for example, the inability to get sick, the subject due to the exclusion of secondary threats, which are excluded, at the period of developing the software, that the subject is equipped with.

3. A robot (possibly, robot-humanoid) that is an artificial replica of a living organism, such as a human.

Advantages:

- The mental activity of the subject is close, in comparison, to that of the human;
- The exit from the working state of the subject does not harm a conscious human;
- Maintaining a conversation, in approximation, to an equal level, the subject with a person and/or a group of people;
- Rapid adaptation to new conditions, to a greater extent, without harm to the health of the subject.

Disadvantages:

- In comparison with the AI model from the second method, high energy costs are required to maintain the work of the subject model;
- In comparison with the AI model from the second method, the database of the subject model is not perfect;
- Information that is stored and reproduced during the activity of the NS of the subject is distorted, under any conditions; also, in approximation, as in the activity of the human NS;
- The possibility of sabotage is not ruled out.

5. The discussion of the result.

One of the options could be one, in which it would be possible to gain full control over the artificial CNS in order to eliminate possible conflict situations, in which a fatal outcome of an astronaut is likely. However, any change, that was made to such a system, will affect its integrity – such a system will cease to be an artificial replica of the CNS of a living organism, but will become a controlled model of AI. Perhaps the observance of most of the conditions for life and work both for human and for the “machine”, without making him a “slave” of humanity, will provide them with full cooperation.

Therefore, today, for the passage of space missions, an appropriate option, in which the threat to the health of the astronaut will be minimal, is the use of robots, that are equipped with AI and, at the same time, are amenable to human control.

Conclusions

Briefly, the main problem was described – the threat to the health of astronauts, who are outside the earth's atmosphere. Known methods, that can be applied to correct the problem, are described. After discussing the results of the comparison, it became clear, that, today, the AI NS model cannot be accepted for participation in space missions, due to the possible occurrence of unforeseen situations, that could become life-threatening. It is possible, that compliance with most of the conditions for life and work for a human and an “artificial human” would

ensure full cooperation for both. Today, the most favorable option is to use a robot, that is equipped with AI and has access to control all its actions by the human.

References

1. Martinussen M. Aviation Psychology and Human Factors. Second Edition / M. Martinussen and D. R. Hunter. – Boca Raton : CRC Press. Taylor & Francis Group, 2018. – 347 p.

2. De La Torre G. G. Future Perspectives on Space Psychology: Recommendations on Psychosocial and Neurobehavioral Aspects of Human Spaceflight / G. G. De La Torre, B. van Baarsen, F. Ferlazzo and oth. // Acta Astronautica. – 2012. – Vol. 81. – Is. 2. – 587-599 pp. DOI: 10.1016/j.actaastro.2012.08.013

3. Smith L. M. The Psychology and Mental Health of the Spaceflight Environment: A Scoping Review / L. M. Smith // Acta Astronautica. – 2022. – Vol. 201. – 496-512 pp.

4. Arone A. The Burden of Exploration on the Mental Health of Astronauts: A Narrative Review / A. Arone, T. Ivaldi, K. Loganovsky and oth. // Journal of Treatment Evaluation. Clinical Neuropsychiatry. – 2021. – Vol. 18. – Is. 5. – 237-246 pp.

5. Pagnini F. Human Behavior and Performance in Deep Space Exploration: Next Challenges and Research Gaps / F. Pagnini, D. Manzey, E. Rosnet and oth. // Nature Partner Journal (npj) Microgravity. – 2023. – Vol. 9. – 27.

6. Beheshti A. Genomic Changes Driven by Radiation-Induced DNA Damage and Microgravity in Human Cells / A. Beheshti, J. T. McDonald, M. Hada and oth. // International Journal of Molecular Sciences. – 2021. – Vol. 22. – Is. 19. – 10507.

7. Russo A. Using Artificial Intelligenc for Space Challenges: A Survey / A. Russo and G. Lax // Applied Sciences. – 2022. – Vol. 12. – Is. 10. – 5106.

8. Yan F. Language-Facilitated Human-Robot Cooperation within a Human Cognitive Modeling Infrastructure: A Case in Space Exploration Task / F. Yan, L. Shiqi, Q. Kan and oth. // 2020 IEEE International Conference on Human-Machine Modeling Infrastructure: A Case in Space Exploration Task. – 2020. – 1-3 pp.

9. Tomashuk A. S. Information for Forming a Model of Artificial Intelligence, Which Describes the Work of the Human Central Nervous System / A. S. Tomashuk // Colloquium-journal. – 2022. – Vol. 17. – Is. 140. – 30-45 pp.

10. Tomashuk A. S. Structure and Functions of the Cortic Areas of the Human Brain / A. S. Tomashuk // Colloquium-journal. – 2022. – Vol. 20. – Is. 143. – 33-45 pp.