DOI: https://doi.org/10.5281/zenodo.14933138

UDC: 004.89

ANALYSIS OF PROSPECTIVE ARTIFICIAL INTELLIGENCE TECHNOLOGIES

Alevtina Aleksandrovna Muradova
TUIT named after Muhammad al-Khwarizmi, PhD, associate professor of the Department of Telecommunication Engineering
a.muradova1982@inbox.ru

Svetlana Aleksandrovna Sadchikova
TUIT named after Muhammad al-Khwarizmi, PhD, associate professor of the Department of Telecommunication Engineering
sadchikova047@gmail.com

ABSTRACT

The article presents an analysis of promising technologies and trends in the development of artificial intelligence. The role of neural networks in solving control and optimization problems is shown. The use of AI technologies in the military sphere is considered. An example of the Smart Sensor Web project is given, which provides for the organization of a distributed network of various sensors that work synchronously on the battlefield.

Keywords: *promising technologies, AI approaches, evolutionary computing, expert systems, intelligent engineering, military technologies.*

АНАЛИЗ ПЕРСПЕКТИВНЫХ ТЕХНОЛОГИЙ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА

АННОТАЦИЯ

В статье представлен анализ перспективных технологий и тенденций развития искусственного интеллекта. Показана роль нейронных сетей в решении задач управления и оптимизации. Рассмотрены применение технологий ИИ в военной сфере. Приведен пример проекта Smart Sensor Web, который предусматривает организацию распределенной сети разнообразных датчиков, синхронно работающих на поле боя.

Ключевые слова: *перспективные технологии, подходы ИИ, эволюционные вычисления, экспертные системы, интеллектуальная инженерия, военные технологии.*

INTRODUCTION

AI Problems Are Related to Resources. Reports on the unique achievements of specialists in the field of artificial intelligence (AI), promising unprecedented opportunities, disappeared from the pages of popular science publications many years ago. The euphoria associated with the first practical successes in the field of AI passed rather quickly, because the transition from the study of experimental computer models to solving applied problems in the real world turned out to be much more difficult than expected. Experts from all over the world drew attention to the difficulties of such a transition, and after a detailed analysis it turned out that almost all the problems are related to the lack of two types of resources: computer (computing power, RAM and external memory capacity) and human (science-intensive development of intelligent software requires the involvement of leading specialists from various fields of knowledge and the organization of long-term research projects). To date, resources of the first type have reached (or will reach in the next five to ten years) a level that allows AI systems to solve practical problems that are very difficult for humans. But the situation with the second type of resources in the world is even worsening - this is why achievements in the field of AI are associated mainly with a small number of leading AI centers at major universities [1,2].

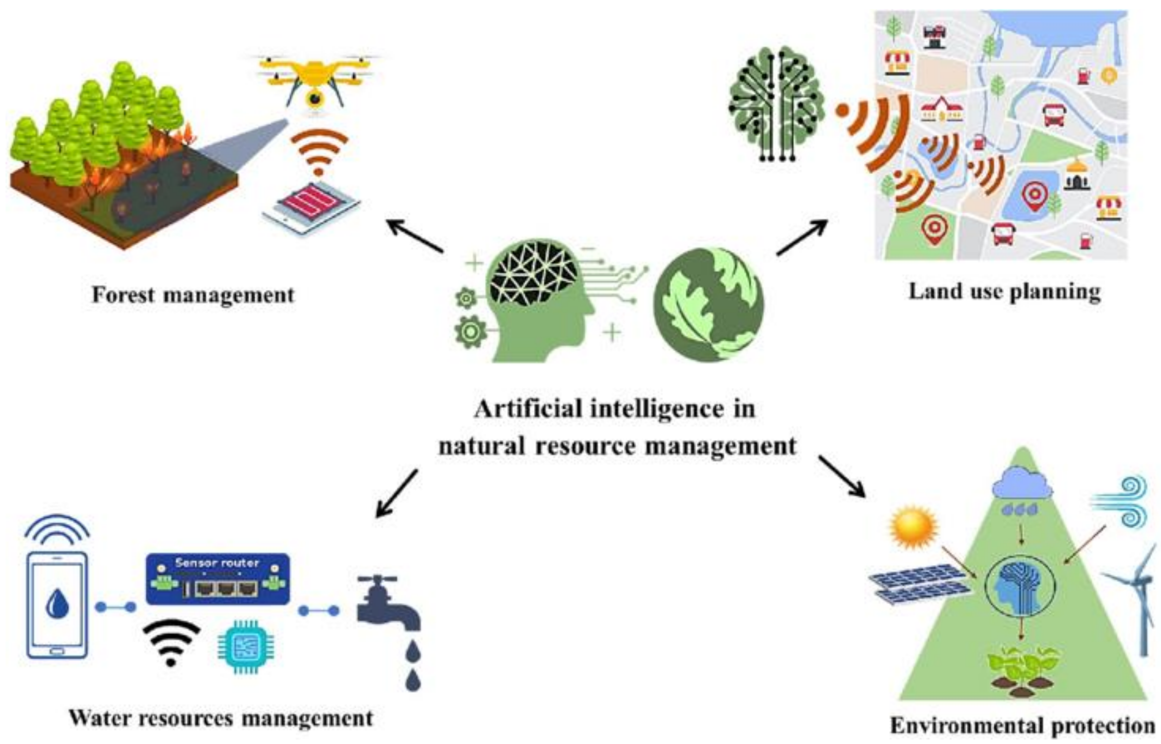

Fig.1. Applications of artificial intelligence in natural resource management

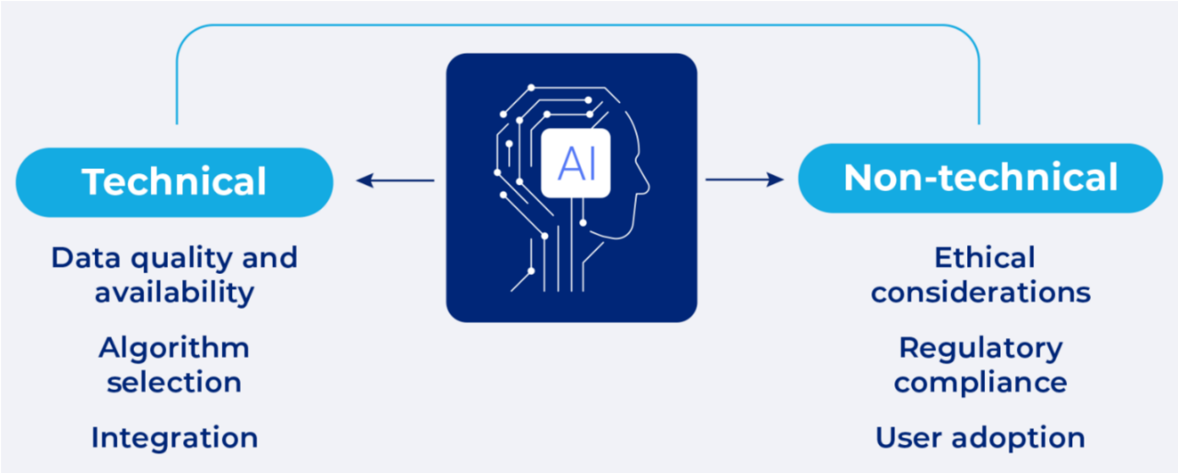

Fig.2. Types of AI challenges

RESEARCH OBJECT AND METHODS

Promising technologies. Let's draw a general picture of the development of various areas of AI by analyzing the topics of European and American conferences on AI over the past few years. First, let's consider the most actively developed AI approaches - in descending order of their popularity among specialists. It should be noted that lower popularity is often associated not so much with the potential of the technology, but with the remoteness of the prospects for its applied implementation (for example, the extremely high potential of cyber factories does not yet arouse serious interest due to the presence of many unsolved problems in their management).

1. Neural networks. This area is steadily holding first place. The improvement of learning and classification algorithms in real time, natural language processing, image recognition, speech, signals, as well as the creation of intelligent interface models that adapt to the user, continues. Among the main applied problems solved with the help of neural networks are financial forecasting, data mining, system diagnostics, network activity control, and data encryption. In recent years, there has been an intensive search for effective methods of synchronizing neural networks on parallel devices.

2. Evolutionary Computing. The development of the field of evolutionary computing (EC; autonomous and adaptive behavior of computer applications and robotic devices) was significantly influenced primarily by investments in nanotechnology. EC touches upon practical problems of self-assembly, self-configuration, and self-healing of systems consisting of many simultaneously functioning nodes. In this case, it is possible to apply scientific achievements in the field of digital automata.

Another aspect of EC is the use of autonomous agents for solving everyday problems as personal secretaries managing personal accounts, assistants selecting the necessary information in networks using third-generation search algorithms, work planners, personal teachers, virtual sellers, etc. Robotics and all related areas also belong here. The main areas of development are the development of standards, open architectures, intelligent shells, script/query languages, and methodologies for effective interaction between programs and people. Autonomous behavior models are expected to be actively implemented in all sorts of household devices capable of cleaning rooms, ordering and cooking food, driving cars. In the future, autonomous agent teams will be used to solve complex problems (quickly exploring the contents of the Network, large data arrays like genomic data). This will require studying possible directions of evolution of such teams, planning joint work, communication methods, group self-training, cooperative behavior in fuzzy environments with incomplete information, coalition behavior of agents uniting "by interests", learning to resolve interaction conflicts. Social aspects stand apart - how society will treat such communities of intelligent programs in practice [3].

3. Large groups of different technologies are in third to fourth place.

3.1 Fuzzy logic. Fuzzy logic systems will be most actively used mainly in hybrid control systems. 3.2 Image processing. The development of methods for representing and analyzing images (compression, encoding during transmission using various protocols, processing biometric images, satellite images) independent of playback devices, optimization of color representation on the screen and when printing, distributed methods for obtaining images will continue. Further development will be given to means of searching, indexing and analyzing the meaning of images, coordinating the contents of reference catalogs during automatic cataloging, organizing copy protection, as well as machine vision, algorithms for recognizing and classifying images. 3.3. Expert systems. The demand for expert systems remains at a fairly high level. The greatest attention today is drawn to decision-making systems on a time scale close to real time, means of storing, retrieving, analyzing and modeling knowledge, dynamic planning systems. 3.4. Intelligent Applications. The growth in the number of intelligent applications capable of quickly finding optimal solutions to combinatorial problems (arising, for example, in transportation tasks) is associated with production and industrial growth in developed countries. 3.5. Distributed Computing. The spread of computer networks and the creation of high-performance clusters have generated interest in distributed computing issues - resource balancing, optimal processor loading, self-configuration of devices for maximum efficiency, tracking elements that require updating, identifying inconsistencies between network objects, diagnosing the correct operation of programs, and modeling such systems.

3.6. OS RD. The emergence of autonomous robotic devices increases the requirements for real-time OS - organizing self-tuning processes, planning maintenance operations, using AI tools to make decisions under time pressure.

3.7. Intelligent Engineering. In recent years, companies involved in organizing the development processes of large software systems (software engineering) have shown particular interest in AI. AI methods are increasingly used to analyze source texts and understand their meaning, manage requirements, develop specifications, design, code generation, verification, testing, quality assessment, identify the possibility of reuse, and solve problems on parallel systems. 3.8. Self-organizing DBMS. Self-organizing DBMS will be able to flexibly adapt to the profile of a specific task and will not require administration.

4. The next most popular group of AI technologies. 4.1. Automatic analysis of natural languages (lexical, morphological, terminological, detection of unfamiliar words, recognition of national languages, translation, error correction, efficient use of dictionaries). 4.2. High-performance OLAP analysis and data mining, methods for visually specifying queries. 4.3. Medical systems that consult doctors in emergency situations, robotic manipulators for performing precise actions during surgeries. 4.4. Creation of fully automated cyber factories, flexible lean manufacturing, rapid prototyping, work planning, supply chain synchronization, authorization of financial transactions by analyzing user profiles [4-6].

RESEARCH RESULTS AND THEIR DISCUSSION

AI in the Land of the Rising Sun. The profile of Japanese conferences (and this country has many original and unique achievements in the field of AI) does not differ much from the global one. These differences are all the more interesting - they attract significant investment from public and private Japanese organizations.

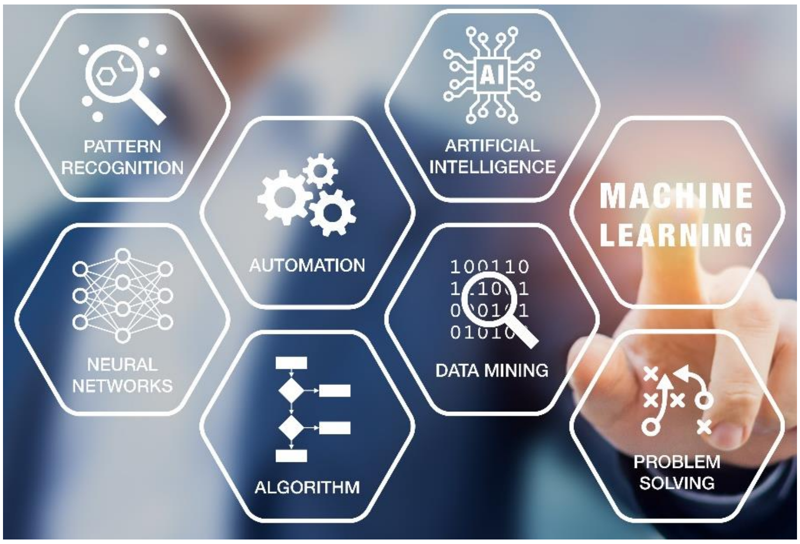

Fig.3. Interaction of artificial intelligence with other fields

Among the areas that are more popular in Japan compared to European and American AI schools, we note the following: creation and modeling of e-markets and e-auctions, bioinformatics (electronic cell models, analysis of protein information on parallel computers, DNA calculators), natural language processing (self-learning multilingual systems for recognizing and understanding the meaning of texts), the Internet (integration of the Network and all kinds of real-time sensors in residential buildings, intelligent interfaces, automation of routine work based on the formalization of applied and system concepts of the Internet, iterative technologies for extracting the necessary information from large volumes of data), robotics (machine learning, effective interaction of autonomous devices, organization of movement, navigation, action planning, indexing of information describing movement), methods of knowledge representation and processing (improving the quality of knowledge, methods for obtaining knowledge from human experts, data mining and search, solving real-world problems on this basis - for example, document management) [7-9].

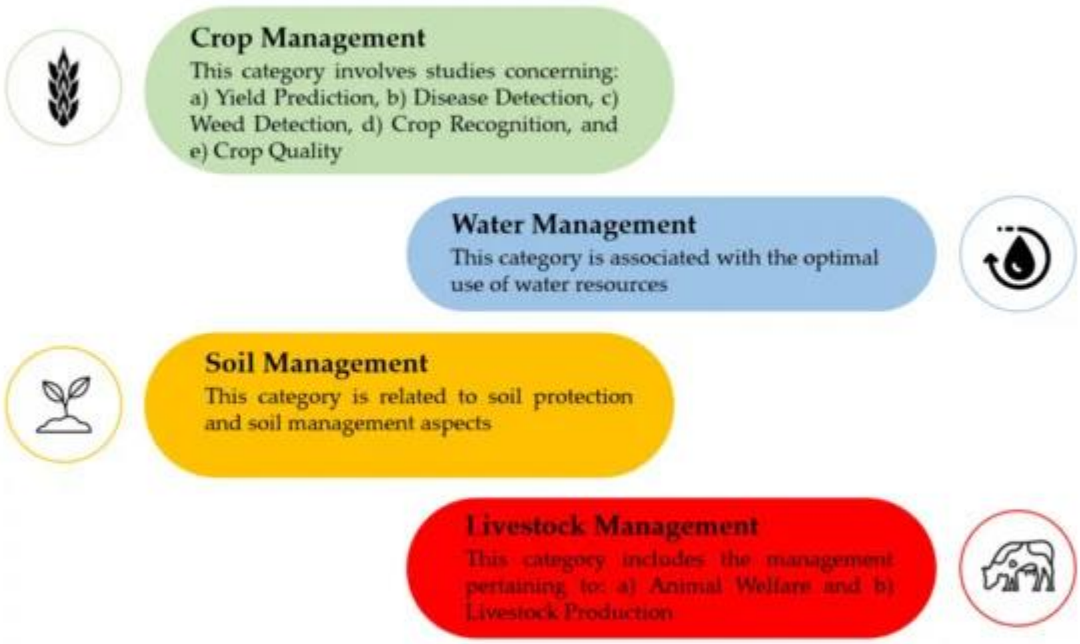

Fig. 4. The four generic categories in agriculture exploiting machine learning techniques

SCIENTIFIC RESEARCH RESULTS AND CONCLUSION

Military technologies. Research in the field of neural networks, which allow obtaining good (albeit approximate) results in solving complex control problems, is often financed by the military scientific agency DARPA. An example is the Smart Sensor Web project, which involves organizing a distributed network of various sensors that work synchronously on the battlefield. Each object (costing no more than $300) in such a network is a source of data - visual, electromagnetic, digital, infrared, chemical, etc. The project requires new mathematical methods for solving multidimensional optimization problems. Work is underway on automatic target recognition, analysis and prediction of equipment failures based on deviations from typical parameters of its operation (for example, by sound) [10-13].

Operation "Desert Storm" became an incentive for the development of expert systems with advanced AI used in the field of supply. All high-precision weapons are based on developments related to machine vision technologies.

Fig.5. AI in Military Technologies. Department of Defense

FINAL CONCLUSION

The key factor determining the development of AI technologies today is the growth rate of computing power of computers, since the principles of the human psyche are still unclear (at the level of detail available for modeling). The growth of productivity of modern computers in combination with the improvement of the quality of algorithms periodically makes it possible to apply various scientific methods in practice. This happened with intelligent toys, this is happening with home robots. Once again, temporarily forgotten methods of simple enumeration of options (as in chess programs), which get by with an extremely simplified description of objects, will be intensively developed. But with the help of this approach (the main resource for its successful application is productivity), it is expected that many different problems will be solved (for example, in the field of cryptography). Quite simple, but resource-intensive algorithms of adaptive behavior will help autonomous devices to operate confidently in a complex world. At the same time, the goal is to develop systems that do not look like a person, but act like a person. The active introduction of formal logic into applied systems of knowledge representation and processing will continue. The field of AI, which has become a mature science, develops gradually - slowly but steadily moving forward. Therefore, the results are quite predictable, although sudden breakthroughs associated with strategic initiatives are not excluded along this path.

REFERENCES

1. Schmidhuber, J. (2015). Deep learning in neural networks: an overview. Neural Networks, № 61, pp. 85-117.
2. Alai, M. (2004). AI, scientific discovery and realism. *Minds and Machines*, Vol. 14, No. 1, pp. 21 - 42.
3. Chan, C. W. & Huangb, G. H. (2003). Artificial intelligence for management and control of pollution minimization and mitigation processes. *Engineering Applications of Artificial Intelligence*, Vol. 16, Issue 2, pp.75-90.
4. Clocksin, W.F. (2003). Artificial intelligence and the future. *Philosophical Transactions: Mathematical, Physical & Engineering Sciences*, Vol. 361, № 1809, pp.1721-1748.
5. Muradova, A.A. (2025). Using kohonen neural networks and fuzzy neural networks in intelligent analysis of IoT sensor information, *Multidisciplinary Scientific Journal SCHOLAR*, Vol.3, Issue1, ISSN: 2181-4147, pp. 4–11.
6. Muradova, A.A., Sadchikova, S.A. (2025). Analysis of fuzzy neural control systems for telecommunication networks. *"Research and education" scientific journal*, ISSN 2181-3191, Vol.4, Issue1, ISSN: 2181-4147, pp. 7–14.
7. Muradova, A.A. (2023). Blockchain to improve the internet of things. International Conference on Research in Humanities, Applied Sciences and Education. Dubai, U.A.E. November 30-th.
8. Muradova, A.A. (2023). Cyber security risks of IoT devices. Republican scientific and practical conference "Role of information and communication technologies in the formation of innovative economy". Tashkent, Uzbekistan.

9. Muradova, A.A. (2023). Network security of the internet of things (IoT) in organizations. Problems of information security and cyber security in the field of information technologies and communications, Republican scientific and practical conference". TUIT. Tashkent, Uzbekistan.
10. Muradova, A.A. (2023). Reliability and security of the Internet of things. *Multidisciplinary Scientific Journal SCHOLAR*, Vol.1,27, pp. 109-117.
11. Muradova, A.A. (2023). Challenges and Future Trends of Reliable Internet of Things. *Multidisciplinary Scientific Journal SCHOLAR*, Vol.1,29, pp. 55–65.
12. Muradova, A.A. (2023). Basic steps to secure the Internet of Things. *Multidisciplinary Scientific Journal SCHOLAR*, Vol.1,31, pp. 71-76.
13. Muradova, A.A. & Begmatov, Sh.A. (2024). Methods for managing the reliability and quality of IoT sensors. *Multidisciplinary Scientific Journal GOLDEN BRAIN*, Volume 2, Issue 4, pp. 49-58.