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AI AGENTS AND MULTIAGENT SYSTEMS

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Annotatsiya: *Al agentlari va multiagent tizimlari so'nggi yillarda ilmiy va texnik sohalarda tobora dolzarb ahamiyat kasb etmoqda. Ushbu soha muhandislik, informatika, boshqaruv, iqtisod va boshqa turli sohalarda keng tatbiq qilinmoqda. Agentlar atamasi zamonaviy ilmda keng ma'noda ishlatiladi va o'zida mustaqil faoliyat yurituvchi, muayyan maqsadga intiluvchi va muhit bilan o'zaro ta'sirda bo'ladigan sub'ektlarni anglatadi. Agentlar turli tashqi va ichki axborotlarni qabul qilib, uni tahlil qilish, qaror qabul qilish, harakat ishlab chiqish qobiliyati bilan tavsiflanadi. Agentlarning asosiy fazilatlari bo'lib, avtonomlik, reaktivlik, proaktivlik va muvofiqlikni ko'rsatish mumkin.*

Kalit so'zlar: *Al agentlari, multiagent tizimlari, avtonomlik, reaktivlik, proaktivlik, muvofiqlik, axborot almashinuvi, muvofiqlashtirish, tizim arxitekturasi, resurs taqsimoti.*

Аннотация: *В последние годы Al агенты и многоагентные системы приобретают всё большую значимость в научно-технических областях. Эта область широко используется в инженерии, информатике, менеджменте, экономике и различных других областях. Термин «агенты» используется в широком смысле в современной науке и относится к субъектам, которые действуют самостоятельно, преследуют определённую цель и взаимодействуют с окружающей средой. Агенты характеризуются способностью получать различную внешнюю и внутреннюю информацию, анализировать её, принимать решения и разрабатывать действия. Основные*

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качества агентов можно охарактеризовать как автономность, реактивность, проактивность и координацию.

Ключевые слова: *Al агенты, многоагентные системы, автономность, реактивность, проактивность, координация, обмен информацией, координация, архитектура системы, распределение ресурсов.*

Abstract: *In recent years, Al agents and multiagent systems have become increasingly important in scientific and technical fields. This field is widely used in engineering, computer science, management, economics and various other fields. The term agents is used in a broad sense in modern science and refers to entities that operate independently, pursue a specific goal and interact with the environment. Agents are characterized by the ability to receive various external and internal information, analyze it, make decisions, and develop actions. The main qualities of agents can be characterized as autonomy, reactivity, proactivity, and coordination.*

Keywords: *AI agents, multiagent systems, autonomy, reactivity, proactivity, coordination, information exchange, coordination, system architecture, resource allocation.*

INTRODUCTION

In recent years, Artificial Intelligence has greatly advanced, and at the heart of many intelligent systems are AI agents. An AI agent is a system that can perceive its environment through sensors and act upon that environment using actuators, making decisions through reasoning, learning, and planning. These agents can be as simple as a program playing chess, or as complex as autonomous vehicles navigating city streets. A more sophisticated and powerful concept in AI is the multiagent system. A multiagent system consists of multiple interacting agents, each with their own goals, knowledge, and capabilities. These agents may cooperate to achieve common objectives, compete for resources, or negotiate to reach mutually beneficial agreements. Multiagent systems are inspired by the way complex tasks are accomplished in nature through decentralized decision-making, such as ant colonies, flocks of birds, or even human societies. The study of AI agents and multiagent systems is essential for solving complex problems where a single agent is not

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sufficient. Examples include distributed robotics, smart grids, network routing, e-commerce, and collaborative filtering. Understanding how to design, implement, and analyze these systems allows us to create more flexible, efficient, and robust solutions for real-world problems.

MATERIALS AND METHODS

Autonomy is understood to mean that an agent can independently carry out his activities, independently assess the signals coming from the external environment or from other agents himself. Reactivity refers to the ability of an agent to respond quickly and efficiently to changes occurring in its environment. Proactivity, on the other hand, is due to the fact that agents not only respond to existing situations, but also act according to plan, anticipating future events. Compliance, i.e., the ability of an agent to operate in cooperation with other agents, increases the chances of positive results in structural systems. Agents can usually be objects of a programmatic or physical form. Software agents are widely used in the creation of information search, e-commerce, internet service, management systems. An example of a physical agent is, for example, robots. However, the term agent does not always refer to a single entity; it often refers to purposeful actions achieved through the joint activities of agents. When agents work together, their activities can be both independent and interdependent. The result is the concept of multiagent systems (MAT). A Multiagent system is a structural system consisting of a large number of agents, each of which specializes in performing a certain large or small task, is independent and can exchange information with each other. The MAT allows you to control the complexities present in this area, achieve effective results on a larger scale, provide savings and convenience. Multiagent systems will have many basic qualities. Each agent in such systems has its own knowledge and experience, can independently make decisions. Each element of the system is able to choose its own priority and monitor the situation around it. These systems have proven their effectiveness in solving complex problems, in the process of optimal resource allocation, monitoring in networks, conducting analyzes [1].

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There are several principled present-day approaches to the creation and use of Multiagent systems. The first is that in a multi-agent environment, each agent must clearly define their goals and know what actions are necessary to carry out in order to achieve these goals. This, in turn, determines the need for the application of algorithms for managing the information and Knowledge Base, decision-making mechanisms, external and internal information flows in the programming of agents. In order for agents to work efficiently, their individual actions are asked to bring an overall result to the system. This, in turn, requires the development of mechanisms for information exchange among agents. In the system, each agent can monitor the actions of others, evaluate what they have done, change their program of action if necessary [2].

RESULTS AND DISCUSSIONS

The second important approach of Multiagent Systems is the development and improvement of agent interaction mechanisms. Agents must communicate their information quickly and correctly through modern communication protocols with each other. In systems, these processes are introduced in the form of a standardized information exchange format, the use of a common language and code, rules for the use of common resources. The third major approach of Multiagent Systems is to organize Inter-agent coordination processes. It is necessary that many agents come to an agreement between themselves in finding a solution to one problem, come to a common decision, that their action be systematic and complementary. When organizing this process, researchers use several coordination models. For example, one can distinguish between centralized and decentralized (distributive) control mechanisms. Multiagent Systems also have problems and obstacles. For example, they may have imbalances due to agents acting against each other in their own interests, misallocation of resources, delays in information exchange. In such cases, it becomes necessary to find an optimal solution to problems by controlling the system, reprogramming agents, controlling their actions, analyzing the environment [3].

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In Multiagent Systems, the level of knowledge, experience, resource ownership of each agent, the level of pursuit of the goal, independence may differ. If agents are self-guided, adaptable to conditions, the system will have a more flexible appearance. The adaptive nature of agents allows them to function efficiently even in complex and rapidly changing environments. In such systems, each agent can adapt their activities by accepting new tasks. In Multiagent Systems, special attention is paid to the structure of the information flow, decision-making, coordination of actions, resource use processes, management system. The system architecture can be of several levels: individual Agent levels, local group agents, and the entire system level. With this architecture, each agent is also instrumental in the success of the entire system, rather than remaining solely responsible for its activities.

The areas of application of Multiagent systems are very wide. In such areas as the management of large industrial facilities, transport networks, economic Process Management, Information Security, social networks, logistics, Ecology, Energy, this approach works effectively. Partially or fully automated multiagent systems make it possible to ensure fast, reliable and efficient control in complex and changing conditions. One characteristic feature of Multiagent Systems is the new quality that appears in the system, that is, the synergistic effect. In doing so, agents act together to achieve a result beyond their personal capabilities. That is, if there is unity, cooperation and agreement within the system, the result achieved by each agent is summed up and the overall system efficiency increases. This demonstrates the need to explore Inter-agent coordination, leadership, resource allocation, and other collaborative issues with depth. In Multiagent systems, indicators such as safety, reliability, efficiency and adaptability are important. In order to work reliably in the system, each agent must constantly perform its function, quickly recover in emergency situations, and the exchange of information with others must be continuous. In addition, issues of System Analysis, control and continuous improvement in practice are also always relevant [4].

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When designing Multiagent systems, analysis on Agent action algorithms, mutual information exchange channels, resources attached to each agent, decision-making principles, network architecture, and information security is studied in depth. To improve the efficiency of the system, constant monitoring and quality analysis are carried out, and the existing problems are eliminated quickly, by finding an optimal solution. Scientific research on Multiagent systems shows that the mechanisms of inter-agent intellectual coordination, decision-making in unity, flexibility to agents, self-control in practice give a significant positive result. These systems make it possible to take the areas of Technology, Management, economy to a new level in perspective. The independence, mobility, coordinated cooperation of agents make multiagent Systems the most important mechanism in solving complex and important tasks. Multiagent Systems also have a special role in social life. For example, in the implementation of the principles of management and coordination in solving certain problems in society, a multiagent approach is used. This suggests that individuals or groups can be directed towards a common goal while maintaining their independence. As a result, each participant feels the result of their activities and makes a blessed contribution to the overall work. Multiagent systems will retain their significant place in each area in the future. The widespread use of such systems in Computer Technology, Management, transport, ecology, production systems increases efficiency, relieves human labor and ensures effective management. Further improvement of Multiagent systems and the creation of new opportunities are among the main issues facing researchers in the field [5].

CONCLUSION

Multiagent systems have an incomparable place in the modern world in solving complex problems, optimally distributing resources, implementing coordinated management, achieving quick and reliable results. Their main advantage is the ability to efficiently and flexibly manage complex systems through an independent and co – acting agent-based structure. Scientific research related to the deep study, further development and implementation of Multiagent systems will continue to be relevant in the future. In this way, multi-agent systems are becoming

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an integral part of our modern life and marking a new stage in scientific and technological progress.

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