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Major Trends in Today's Intelligent Robotics in Light of the Creation of Collaborative Artificial Intelligence

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Abstract: *Robotics and advances in artificial intelligence are breakthrough innovations with considerable promise and the potential to radically change the economic and social aspects of society. Research on the development of robotics is still scarce. This article fills the gap by analyzing the creation and diffusion of robotics innovation and the role of intellectual property in this process. The robotics innovation ecosystem is based on cooperative networks of independent specialists, scientific organizations, and companies. The state plays a significant role in supporting the innovation activity in the considered sphere, first of all, through grant financing, placement of defense orders and implementation of national strategies of robotics development. Competitions and prizes are an important incentive for creating innovations. Patenting is used by companies to protect intellectual property from encroachment by third parties, to ensure freedom of action, to license technology, and to protect against prosecution. The industrial revolution has changed the very notion of means and means of production in the minds of the masses in such a way that the process of robotization and the introduction of artificial intelligence in different areas of life has become inevitable. The article presents an analysis of possible ways of disclosing the concept of "artificial intelligence" as a legal category and its correlation with the concept of "robot", considers the issues of legal responsibility for the performance of work by artificial intelligence, studies the possibility of recognizing the holder of artificial intelligence work as a subject of law.*

Keywords: *Innovation; patent; copyright; autonomous systems; technological processes.*

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Introduction

Artificial intelligence and robotics as autonomous branches of science are gaining intense parallel development both theoretically and practically. Today, innovative robotic and intelligent systems are widespread outside research centers. State corporations and business representatives are interested in developments in the field of robotics and artificial intelligence; various startups are organized for the implementation of such developments, etc. Robotics and artificial intelligence today are becoming part of human life, so legal assessment of their nature and regulation of their use have become the most important tasks of current domestic jurisprudence.

According to the domestic authors, Palahin et al. (2017), Shevchenko (2016), Lubko & Sharov (2019) these categories are not only voluminous, but also semantically do not coincide. Analysis of the conceptual apparatus of the mentioned terms allows us to conclude that, unlike the first, the second is inherent in the presence of "intelligence", self-development, etc. legal status of exactly robots, and not artificial intelligence. In the future the topic will not lose its relevance.

Foreign scientists Cameli et al. (2011), Brynjolfsson & McAfee (2014) note that among the available approaches to the consideration of robots and artificial intelligence as subjects of law the most reasonable way built by analogy with the legal entity in terms of the theory of fiction. Approaches that propose to justify the legal personality of robots and artificial intelligence taking into account the essence of animate entities possessing real and not only formal legal freedom will only be developed after digital technology has reached an objectively high level.

The purpose of this article is: Theoretical analysis of artificial intelligence as the main direction of development of robotic systems, consider the concept of breakthrough technology, innovation, intellectual property in the context of robotics and explore the prospects of innovation and technological development of robotics and collaborative artificial intelligence.

Artificial intelligence as the main direction of development of robotic complexes

The development of present-day robotics is closely related to advances in artificial intelligence. This is due to the rapid development of information technologies, growth of available data and computing power, as well as the high results achieved in solving narrowly focused tasks that

mimic human cognitive functions - the so-called weak artificial intelligence. Since the beginning of the new millennium, there has been a demand for universal multitasking robots with cognitive abilities, such as learning, adaptation and natural interaction with humans.

That is, the very research and development that had been the focus of researchers in the field of artificial intelligence for the past 60 years (expert and human-machine systems, natural language processing) became in demand. It was the successes achieved in the field of artificial intelligence that caused a renewed interest in expanding the capabilities of robotic systems. Technical possibility to realize intellectual functions of such systems caused the growth of computer power and miniaturization of component base.

We see no need in this article to analyze in detail all existing definitions and approaches to the problem. Let us focus on the key words: "intellect" and "artificial intelligence". "Intellect" is defined as a relatively stable structure of an individual's mental abilities. In general terms, intelligence is a system of cognitive abilities of an individual, reflecting sensation, perception, memory, imagination and thinking. Intelligence is an indicator of the overall mental performance of a person, which also includes the generalization of behavioral traits associated with successful adaptation to new conditions of life.

Ramazanov & Tishkov (2017) characterize intelligence as a global ability to act reasonably, think rationally, cope well with the circumstances of life. Along with this there is the concept of general intellect, which is considered as a complex integral quality, a certain synthesis of mental qualities, ensuring the success of any activity. General intellect is also understood as a system of mental mechanisms that allow to form an objective picture of what is happening inside a person. The presence of intelligence is evidence of the ability to theoretical generalization and creative thinking, which includes the ability to independently solve problems, as well as to independently set them. Intelligence refers to the ability to plan, organize, and control one's actions to achieve a goal. From this point of view, devices with artificial intelligence also fall under this definition. Intelligence can be updated only in the information space. Each type of activity forms its own information space. The methodology of its formation and use is based on the principles of intelligence. Principles of organization of embedding new information in the information space, ways of storage and reproduction correspond to the specifics of intelligence work, namely the organization of memory. Thus, information space is also an intellectual space, because it already contains the principles of planning,

organization of use and step-by-step control to achieve the goals (Honchar et al., 2021).

It is fair to say that the development of intelligence is judged by the depth of knowledge and a person's ability to store it in memory, as well as effectively and efficiently use it. Intellectual process is a mental process and in the conditions of cognitive contact of a person with the world provides the possibility of data entry into the thinking apparatus and transformation into information.

There are dozens of approaches to defining the concept of "intelligence". Different approaches lead to several different interpretations of intelligence. The structural-genetic approach is the highest way of harmonization of the subject with the environment, characterized by universality. Intelligence is a set of cognitive operations. Factor analysis approach on the results of testing reveals persistent factors. As noted, intelligence is understood as a system of mental processes that provide the recognition of the ability of a person to assess the situation, make decisions and regulate their behavior accordingly. At the same time, intelligence is interpreted as the ability to cognize and think logically (Kosholap et al., 2021).

Shevchenko & Kuptsova (2020) believe that the one with intelligence is able to extract the essence of a known problem, analyze it, breaking it down into its component parts, and find ways to solve the problem. It is emphasized that intelligence is especially important in uncertain situations, as a symbol that one learns everything new. Another characteristic of intelligence is the ability to make a rational decision when information is scarce.

It is difficult to clearly and unambiguously present the variety of interpretations of the term "artificial intelligence," in the broadest sense artificial intelligence describes the ability of various systems to perform the functions of human intelligence. Artificial intelligence is the science of imitating the human psyche in technical systems. It follows that we are talking about the emergence of intelligence in the machine, similar to humans, which also determined the vector of their development: the study of human mental abilities and the use of generalized results as a basis for developing a variety of intelligent programs that can think, learn and develop similar to human behavior.

Computer scientists, Nikolskny et al. (2015) consider artificial intelligence as a field of computer science engaged in the development of intelligent computing systems, that is, systems with capabilities traditionally associated with the human mind - language understanding, learning,

reasoning, problem solving, etc. New perspective developments appear regularly, and this is connected not only with the constant growth of power and productivity of artificial computers, but also with the attention paid to the work in this sphere by leading countries and largest companies of the world.

Starting from the first decade of the XXI century there is a clear tendency to integrate the developments in the sphere of artificial intelligence and robotics. The main reasons for this trend were:

• exponential growth of available data;

• rapid development of machine learning methods and artificial neural networks;

• development of computing power and hardware, which made it possible to create compact devices with high performance;

• the scientific legacy in the field of artificial intelligence, formed in previous years

Thus, at present, the initial goals of creating intelligent robots have become relevant again. Related to this is the emergence of cognitive robotics, which involves representatives of different disciplines in conducting research, primarily such as psychology and biology, as was the case in the early periods of artificial intelligence development.

It is clear that technological progress leads to the uncontrolled creation of new and improvement of existing dangerous technologies. The fate and lives of many people (and possibly all of humanity) may depend on the actions of small groups of scientists and developers. A special term has emerged to describe a possible stage of technological development. The technological singularity is a hypothetical moment, after which, according to the adherents of this concept, technological progress will become so fast and complex that it will be beyond human understanding (Morze et al., 2016).

The main spokesman for this idea is Ray Kurzweil, futurologist and inventor, author of "The Singularity is Near", and current technical director of machine learning and natural language processing at Google. In doing so, Kurzweil states in a very idealized way that "intelligence is not inherently controllable. This concept is not supported by all scientists, arguing that the development of technology follows an S-curve and that acceleration began to slow down at the end of the last century.

The transition to decision-making by computers would be safe, but the main concerns are the unpredictability of self-conscious systems and the impact of various accidents on them. This is complicated by the inevitable "intelligence explosion".

Baranov (2017) noted that artificial intelligence carries certain social risks - primarily the predicted disappearance of a number of professions (for example, drivers, nurses, and even journalists), the disconnection of people, and perhaps even the loss of natural human skills. The development of technology has always gone the way of excluding humans from the production processes they perform. These processes are complex, because with the disappearance of old professions come new ones related to the new digital economy and the introduction and support of new infrastructure.

In general, however, labor needs should decrease greatly because machines can replace humans in most active (non-creative) activities. Intellectualization, digitalization, and robotization can lead both to social tensions and to the introduction of measures to slow down said processes. The introduction of computer technology has already led to a change in people's mentality - the emergence of the so-called clippiness of consciousness, computer addiction, withdrawal into virtual reality and other negative phenomena. At present it is difficult to assess the global consequences of such factors, but we cannot ignore them.

Robotics: breakthrough technologies, innovation, intellectual property

The dynamic development of the robotics field, the emergence of intelligent robots, artificial intelligence, and the possible consequences of these processes set the stage for lively discussions. The increased attention to robotics stems from the fact that in Europe, the United States, and Japan, humanoid work is already being tested in supermarkets, schools, hospitals, and nursing homes. Engineers, economists, lawyers, and other specialists speculate about the possible applications and socio-economic effects of robotic innovations. In particular, they note the potentially positive (or negative) effects of robots on employment and the social consequences of artificial human companions.

Hollywood movies such as "Ex_Machina" or "Her" have drawn public attention to the ability of artificial intelligence to surpass human intelligence. Experts agree that widespread robotic innovation is inevitable and could have far-reaching consequences. However, despite the increased attention to the industry in question, the development of robotic innovation and the underlying ecosystem remains an understudied process. As intellectual property issues are actively discussed in information, nano-, or biotechnology, the same cannot be said for robotics innovations, which have been the subject of only a few ancient publications in specialized journals.

The purpose of this article is to fill this gap by analyzing the robotics innovation system and the role of intellectual property. We turn to the

history of robotics, assess its potential contribution to economic development, examine the ecosystem of robotic innovation, and analyze the importance of different forms of intellectual property.

Filipe (2017) pointed out that robotics is a technological field that creates robots for different applications: in automotive manufacturing, construction, schools, hospitals, households, etc. In the automobile industry and other industrial sectors, robotics has been used for decades. However, the latest scientific advances in areas such as artificial intelligence and cognitive science have made it possible to create autonomous "advanced" robots with versatile potential to solve economic and social problems.

In a sense, thanks to film fiction, for most people "jobs" are associated for the most part with humanoid jobs, which, however, constitute only a small part of this trend. The Encyclopedia "Britannica" defines a work as "any automatic machine doing human work. According to the International Federation of Robotics (International Federation of Robotics, IFR) "a robot is a working machine programmable in several axes with a certain degree of autonomy and capable of moving within a given environment, performing assigned tasks.

As most scientists and practitioners see it, a robot is "any machine capable of perceiving and responding to its environment based on its own decisions." The key difference between robots and other machines is considered "autonomy": a robot is able to interpret the environment it is in and adapt to the tasks at hand. Work evolves from programmed automatism to semi-autonomous and more autonomous complex systems. Fully autonomous systems can act independently and make decisions without human involvement. By general definition, remotely controlled devices cannot be considered "works", Green (2013).

However, some are still recognized as such. "Remote" robotics devices include telepresence work, remote-controlled androids, robotic surgical devices, exoskeletons, and unmanned aerial vehicles (UAVs) (also called "drones"). The same applies to some toys and educational equipment. Semi-autonomous devices are partly controlled by humans, but unlike remote devices, they provide information that makes it easier for operators to perform tasks and assist in controlling such systems. For example, this group includes semi-automated devices, increasingly used in automobiles, and some industrial jobs that require clear instructions from the operator (Antokhov, 2015).

Fully autonomous devices are capable of making their own decisions among their purpose and performing tasks without human assistance. They can usually think creatively, although they are designed for unpredictable

situations in which it is impossible to prescribe all solutions in advance. Artificial intelligence is an independent field of computational machine and system theory that explores the possibility of creating devices capable of making intelligent decisions. This is important as opposed to fully autonomous devices, although partially blurred.

Sosnina, (2013) refers artificial intelligence to the sphere of robotics, but still more often it is singled out as an independent direction, although it is capable of affecting robotics. Such a view is based on the assumption that artificial intelligence may not have a hardware embodiment, but may exist independently, without being tied to any device.

Innovations in robotics involve the creation of increasingly complex devices, which requires the involvement of resources from different technological industries and sectors of the economy, and thus the participation of different players. To date, the mechanisms of intellectual property rights and other ways of appropriating the results of innovation activities are only in their infancy; it is not entirely clear how they should be formulated.

In addition, due to the wide variety of products and applications, the robotics industry cannot be governed by a universal intellectual property strategy. The phenomena and trends occurring in one segment of robotics do not necessarily apply to others.

First of all, it is the positive effect of such innovations that is logical, predictable and understandable. We will not dwell on this in detail. But the dangers and legal problems that their use entails, as well as the ways to protect human interests deserve a more detailed analysis. The use of artificial intelligence units in government undermines the idea of people governing people based on democratic procedures and principles (Parlett et al., 2018).

The use of artificial intelligence-based social rankings already in use in the PRC completely rejects the principle of equality of citizens, returns society to a caste-based past, and leads to governance based on fear and state violence over a powerless digitized individual. Artificial intelligence units can be successfully used in the judicial process, including analysis of judicial practice and justification of judicial decisions.

This can lead to a violation of citizens' rights to enjoy a fair trial, and expedited judicial review does not always dictate the humanization of judicial activity with fairness. This is the basis of the modern concept of the rule of law, which is enshrined in most modern constitutions of the world, arising from the essence of the primary documents of the EU, raising these principles to the supranational level.

The possibility of robotization and the comprehensive application of artificial intelligence to production calls into question precisely the human right to labor and the use of its results. Here, the existence of the entire set of labor rights, initially in the field of physical labor and later in the field of mental labor, is under attack. The use of artificial intelligence technology makes it possible to openly interfere in private life, nullifying this newly won right. The collection of data about individuals and other personal information also allows for the manipulation of human rights. The use of artificial intelligence creates significant problems in the legal regulation of intellectual property ownership.

And this at a time when services are becoming more expensive than goods, and the material value of the results of intellectual and scientific activity exceeds the value of services, not to mention the fact that they determine the prospects for human development. It is they that are becoming the fundamental values of the world of the future! In light of the development of artificial intelligence and robotics, the problem of electronic personhood recognition has justifiably arisen. Hence, the question of the legal personality of artificial intelligence units, as in society, is divided into two groups:

- the legal personality of Artificial Intelligence units, comparable to the legal personality of a physical person;
- legal personality of artificial intelligence units, comparable to the legal personality of a legal entity.

It is necessary to find such a form of electronic person, a unit of artificial intelligence, which would be able on the legal level and in legal forms to combine and peacefully balance the truly human characteristics and rights of a human creator and what is brought by artificial intelligence. Of enormous importance is the fragile human personality, its consciousness, emotional and sensory perception, not yet accessible to machines. These basic human qualities are also threatened by artificial intelligence. For example, implanting chips into humans that allow them to regulate their behavior could practically turn them into machines and provide control over their behavior.

The most important issue, therefore, becomes the question of preserving the human person, its sovereignty, its truly human qualities and the respect for its dignity. The concept of the electronic person and its comparison with the personality of a human being allows us to speak also about another similar phenomenon closely related to the human person - the "digital (electronic) person".

This includes a number of interrelated components of such an "identity". First of all, it is the digital identification of a person, which is already taking place in practice almost everywhere in the world. It makes it

possible to collect and store all political, financial and economic, business, family and confidential, socio-communicative, medical and any other information that characterizes an individual and influences his or her behavior.

Prospects for innovation and technological development of robotics and artificial intelligence

Artificial Intelligence is reshaping the digital economy and will soon change the economy of the material world. At the beginning of the 21st century, artificial intelligence is helping autonomous machines navigate the material world and interact with humans. In the future, artificial intelligence systems will be able to solve complex systemic problems, such as global carbon dioxide emissions and managing international air traffic flows on a scale that exceeds human capacity. Experts believe that even today's sci-fi movie scenarios could become reality: intelligent operating systems and empathetic digital assistants. Perhaps one day they will be able to perform basic police functions as well.

Modern society has not yet reached a sufficient degree of trust in artificial intelligence systems and works, which is a significant obstacle to the expansion of their use. The reason for this is an increased level of autonomy, reduced human control over their application process, and non-transparent decision-making logic. In addition, there are a number of problems that do not have a single solution, especially on the regulation of these systems.

Among such conceptual problems are: the subject and limits of regulation of artificial intelligence and robots; self-identification of the system in its relationship with a human; legal delegation of decisions by artificial intelligence and robot; liability for harm caused by using the said systems, etc. Special attention deserves the issues of application of artificial intelligence systems and robots in civil law relations, as well as the question of liability for the harm that such systems may cause. But also the question of the protectability of the results of intellectual activity using the above-mentioned technologies remains open. In order to guarantee effective and fair distribution of liability in cases of harm to artificial intelligence systems and works, it is necessary to elaborate the legal framework, taking into account all the issues arising in this regard.

Artificial intelligence already monitors video streams and data collected by multiple sensors, and can prevent security services from reporting suspicious activity. These changes have risk avoidance. For example, works in artificial intelligence management will change the unemployment rate and skills needed for employment, creating tensions in society, and this impact is difficult to predict. Most people remain unclear

about how machine learning algorithms work, which can produce results that reflect common biases that need to be addressed.

Long-term predictions should not forget the threats to humanity's very existence that will arise if human values are not met. There are cybersecurity risks associated with the possibility of artificial intelligence being hacked or cheated. Researchers are trying to begin a discussion about the ethical framework and values that should guide the design and implementation of artificial intelligence and robots. Today, artificial intelligence is acquiring more cognitive abilities that we are used to attributing only to humans, such as general learning and high-level intellectual activity.

Programs using machine learning are beating humans at games that were thought to require human intuition. Computers are already capable of passing a simple Turing test designed to distinguish humans from machines. Advances in advanced materials and sensory technology have improved the perception, movement, and cognitive abilities of machines. Drones and industrial work used to assemble car parts without human input use artificial intelligence to solve complex navigation and interaction problems.

Self-guided work can do things that only humans could do before, such as drive trucks on highways. More and more training programs and research in artificial intelligence and robotics are appearing around the world. By processing data sets too large for human analysis, AI-based programs are solving problems such as climate modeling, calculating nuclear threat scenarios, and managing large-scale sensor networks. They can also gather new financially relevant information by analyzing large amounts of publicly available data. Artificial intelligence not only helps justify decisions, it can also make them on its own (Keisner et al., 2016).

The better artificial intelligence makes decisions, the better the jobs that are driven by those decisions work together with humans, and vice versa. If Rosie the robot is ever to become a reality, machines must learn to recognize human values through observation. As the works learn to better serve us, teach students, fly aircraft, operate patients, and conduct search and rescue operations, issues of trust become paramount. As we become accustomed to artificial intelligence in our daily lives, interacting with it can become the tool we use to interpret the world around us - comparable to steering an airplane on instruments in bad weather. Going to extremes, there is a very real danger of the militarization of artificial intelligence and robots by states and individuals, and various international groups are already exploring the practical and ethical limits of such possibilities.

If the current direction of development continues, the combination of artificial intelligence and robotics will need to be viewed in terms of power,

responsibility and accountability, hence the need for comprehensive management. Research in artificial intelligence is advancing rapidly, with new capabilities increasingly emerging and attracting new investments in research. There are not many experts in the field who believe that machine intelligence is limited and even fewer who believe in its self-limitation. Therefore, it should be prudent to assume that machines will surpass humans (Prots et al., 2021).

So far, the most common way to create machines with general intelligence is to give them goals to achieve and algorithms to look for ways to achieve those goals. A sufficiently capable system will solve whatever task is given to it, so it is necessary to define the task so that the solution found by the machine is provably beneficial to humans. The goal of the machine should be to achieve the human-beneficial goals as fully as possible, but first it will not know what those goals are. It is this uncertainty that avoids the lopsided and potentially disastrous pursuit of incomplete or false goals.

The initial uncertainty can be gradually corrected by the machine by observing people's actions, gaining information about real goals. It is even possible to persuade the machine to allow itself to be disabled: a rational human would do so only if the risk of the machine doing something contrary to the real human is high. goal, which by definition is the machine's goal, so that the machine would then also benefit from disabling it. These ideas offer the faint hope that we will develop an engineering discipline to find a safe approach to benefiting from artificial intelligence-based systems (Keisner et al., 2015).

Artificial intelligence research is challenging. Currently, comparison patterns are established by brute-force and pattern matching, and minor changes in inputs can completely disrupt machine learning models.

Perhaps current approaches lack the constructive robustness to teach artificial intelligence to handle the most complex tasks, such as solving common sense problems or reproducing situational models. Researchers would like machines to be able to act from a situational context and draw general conclusions without first being trained on huge data sets, but so far this is not possible. Perhaps new technologies, such as quantum computing, can change the way artificial intelligence approaches problem information and allow it to learn by receiving feedback, and maybe even mimic human cognitive functions of knowing the world. If this happens, artificial intelligence could be economically profitable, working without the inherent errors and fatigue of humans.

Conclusion

The importance of the article lies in the fact that the development of robotic innovation, the state of the system in which it is created, and the role of intellectual property in these processes remain understudied. This article fills this gap and presents a relevant analysis of the innovation system in the field of robotics. The possibility of robotization and the widespread use of artificial intelligence in manufacturing questions the right of humans to work and use the results. Here the existence of the entire set of labor rights is attacked, first in physical labor and then in intellectual labor. The use of artificial intelligence technologies allows open interference in personal life and destroys the newly won right of people.

The article investigates that the increasing impact of artificial intelligence and robotics on the labor market is expected in both developed and developing regions. Automation may have a negative effect on industrialization in developing countries, reducing the benefits of cheap labor: while much production used to be profitable to locate in developing countries, this practice is now being abandoned.

Thus, having analyzed the conceptual apparatus of the terms "robotics" and "artificial intelligence", we can conclude that, unlike the former, the latter is characterized by the presence of "intelligence", self-development, etc. However, when discussing the legal status of robots and artificial intelligence, most authors allow the confusion of concepts, making attempts to justify the need to give legal status to robots, and not to artificial intelligence.

Implementing the analyzed approaches, it is necessary to take into account the presence of legal and economic validity and social conditionality, as well as a possible theoretical and legal problem, the essence of which is the following: if we introduce new legal entities with legal personality, it may reduce the level of responsibility of professional market participants.

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The Authors 3, 4 considered the concept of breakthrough technologies, innovation, intellectual property in the context of robotics.

The Authors 5, 6 researched the prospects for innovation and technological development of robotics and collaborative artificial intelligence.

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