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Research Results
Резултати от научни изследвания

ARTIFICIAL INTELLIGENCE AND ITS PROTECTION AS AN INVENTION

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Abstract. The subject of this article is artificial intelligence (AI) and its protection as industrial property, more particularly as inventions. It indicates the essence of artificial intelligence and the areas of application of the technology. The protection of the results of AI as inventions is considered, also the advantages and disadvantages of artificial intelligence are presented. The results of the done patent research are analysed. The filed applications for inventions and patents granted in the field of artificial intelligence in a national and international aspect are identified, with conclusions and recommendations for applicant activity in the study area.

Keywords: artificial intelligence; inventions; patent protection; industrial property

JEL: A20, O30

Introduction

For years, since the middle of the last century, robots and machines capable of thinking and creating like living humans have existed only in science fiction and movies. Artificial intelligence (AI) is the subject of research by many universities, research laboratories and large companies involved in the development of advanced information technologies. While the revolutionary technologies of the last century that laid the foundations for the development of many independent industries and new research directions were antibiotics, semiconductors and aircraft construction, today it is nanotechnology, robotics and three-dimensional printing, and the rapid development of information and communication technologies suggests that artificial intelligence could be the breakthrough technology of the near future.

Artificial intelligence is touching almost every area of our lives and revolutionising important aspects of it. The World Intellectual Property Organization (WIPO) is focusing on artificial intelligence with the release of a special report following the development of the technology. This first-of-its-kind document reveals trends in patenting AI innovations, the industry leaders, and analyzes data on patent applications filed and scientific publications issued. AI is changing not only

industries, introducing a new kind of industry, but humanity. This technology has an impact on society in every area, but this impact has both positive and negative sides.

In the present article, the results of AI technology will be considered, and the way in which they are protected as inventions. Artificial intelligence stimulates a more efficient use of resources and transforms the way products are produced. Countries such as **China, the United States, and South Korea** are investing billions in the development of technology and the training of skilled specialists that could be realized in this high-tech field.

1. Essence of Artificial Intelligence

The history of artificial intelligence dates back to the middle of the last century. It is believed that the author of the term "artificial intelligence" was John McCarthy, who first used it in his paper at a conference at Dartmouth University (New Hampshire, USA) in 1956 in the sense of the science and technology of creating "intellectual" machines and, in particular, "intellectual" computer programs.

To date, there is no universally accepted definition of "artificial intelligence", nor a legal term at the level of individual jurisdictions. There are many definitions and understandings, interpreted by different authors according to what is the main subject of discussion or research.

Existing definitions of artificial intelligence can be divided into two broad groups: the first group includes definitions that characterize the field of scientific knowledge, the second group includes definitions that characterize the features and properties of certain devices or systems. As one of the currently most common opinions concerning the first group, the words of R. Kurzweil, who believes that the term "artificial intelligence" means "the science of creating computers capable of doing things that humans do using their intelligence". In the same sense are the statements of D. Castro and J. New, according to which artificial intelligence is "a field of computer science devoted to the creation of computing machines and systems that perform operations similar to human learning and decision-making". The second set of definitions defines "artificial intelligence system" as "the ability of a computing machine to model a thought process by performing functions that are normally associated with human intelligence". Many experts view an artificial intelligence system as a computing machine with computer programs at its core. There is a role for hardware that is not optimized for every type of application to provide higher performance of its semiconductor systems. Hardware, especially new types of quantum devices, can speed up the performance of algorithms used in artificial intelligence systems. (Sesitsky 2018).

Artificial intelligence simulates human behaviour or thinking and can be trained to solve specific problems. **AI is a combination of machine learning and deep**

learning techniques. With machine learning, computers find information without being told where to look. Instead, they use algorithms that learn from data in an interactive process. Machine learning is a general term for a set of techniques and tools that help computers learn and adapt on their own. Machine learning algorithms help AI learn without being explicitly programmed to perform a desired action. By learning a pattern of sample inputs, a machine learning algorithm predicts and executes tasks based solely on the learned pattern, rather than a predefined programming instruction. Deep learning can be viewed as a subset of machine learning. It is a field that is based on learning and self-improvement through the exploration of computer algorithms. While machine learning uses simpler concepts, deep learning works with artificial neural networks that are designed to mimic how humans think and learn (Sesitsky 2018).

One of the familiar applications of machine learning is the way email providers help deal with spam correspondence. Junk mail filters use an algorithm to identify and move new types of unwanted messages to the junk mail folder.

Deep learning supports image classification, language translation, speech recognition. Digital assistants such as "Siri", "Cortana", "Alexa" and "Google Assistant" use deep learning for natural language processing and speech recognition. "Skype" translates spoken conversations in real time. "Google Translate" uses deep learning and image recognition to translate voice and written languages. "Google Planet" can identify where a photo was taken[1].

2. Areas of application of artificial intelligence

Artificial intelligence finds application in almost every sphere of modern human life. It would be difficult to comprehensively define each of its applications, so the article will identify only some of the areas in which AI is involved such as:

2.1. Artificial intelligence in e-commerce

Artificial intelligence technology is helping to improve how businesses connect with their customers. AI-powered assistants or so-called "virtual shopping assistants" help improve the customer experience when shopping online. One example is finding relevant movies on Netflix, where highly accurate prediction technology is provided based on users' reactions to individual movies. Millions of recordings are examined to suggest shows and movies that would be of interest to the viewer, based on their previous movie search choices.

2.2. Artificial intelligence in navigation

Based on research, GPS (Global Positioning System) technology can provide users with accurate, timely and detailed information to improve safety. The technology uses a combination of neural networks, making users' lives easier by automatically detecting the number of lanes and types of roads. Artificial intelligence is widely used by Uber and many logistics companies to improve operational efficiency, analyse road traffic, and optimize routes[2].

2.3. Artificial intelligence in robotics

Robotics is another area where AI applications are being used. AI-powered robots can be used to transport goods, clean offices, and AI in human resources. Companies are using intelligent software to ease the hiring process for new employees. Using machine learning software, AI systems can scan job applicant profiles and resumes to provide businesses with a pool of suitable employees from which they must then make selections.

2.4. Artificial intelligence in healthcare

Artificial intelligence finds a variety of applications in the healthcare sector. AI is being used to build advanced machines that can detect diseases and identify cancer cells. AI can help analyse chronic conditions with lab and other medical data to provide early diagnosis. An organization called Cambio Health Care is developing a clinical decision support system for stroke prevention that can alert a physician when there is a patient at risk for a heart attack. Another such example is Coala life, a company that has a digitized device that can detect heart disease[3].

2.5. Artificial intelligence in agriculture

Artificial intelligence is used to identify defects and nutrient deficiencies in soil. The world will need to produce 50 percent more food by 2050. Artificial intelligence can help farmers get more produce from the land while using resources more sustainably. Issues such as climate change and population growth are prompting industry to look for more innovative approaches to improve yields. Organizations are using automation and robotics to help farmers find more effective ways to protect crops from weeds and pests.

2.6. Artificial intelligence in social media

On social media platforms like Twitter, artificial intelligence is used to identify hate speech and terrorist language in tweets. Machine learning, deep learning and natural language processing are used to filter out offensive content. The company detects and bans 300,000 terrorism-related accounts, 95% of which are identified by intelligent machines[4].

2.7. Artificial intelligence in autonomous vehicles

The development of autonomous vehicles is expected to revolutionise the transport system. Companies like Waymo are conducting test drives in Phoenix before rolling out their first AI-based public service. The AI system collects data from vehicle radar, cameras, GPS, and cloud services to produce control signals that drive the vehicle. Advanced deep learning algorithms can accurately predict what objects are likely to exist in the vicinity of the vehicle. This makes Waymo vehicles more efficient and safer. Another famous example of an autonomous vehicle is Tesla's self-driving car. Artificial intelligence applies computer vision, image detection, and deep learning to build cars that can automatically detect objects and move around without human intervention. According to Elon Musk, Tesla will have fully self-driving cars soon such as "robotaxi"-a vehicle that can carry passengers without a driver behind the wheel[5].

2.8. Artificial intelligence in space

Space expeditions and discoveries always require the analysis of vast amounts of data. Artificial intelligence and machine learning are the best way to process data at this scale. Artificial intelligence is also being used for NASA's Mars rover mission to Mars – Mars 2020. The Mars rover with artificial intelligence is on the red planet and is responsible for autonomously guiding the cameras to perform research on the red planet.

2.9. Artificial intelligence in banking

Many banks have already adopted AI-based systems to provide customer service, detect anomalies and credit card fraud. An example is HDFC Bank, which is developing an AI-based chatbot called 'EVA' (Electronic Virtual Assistant). Since its launch, 'EVA' has responded to over 3 million customer queries, interacted with over half a million users, and held over a million conversations. "EVA" can gather knowledge from thousands of sources and provide simple answers in less than 0.4 seconds. Using AI to prevent fraud is not a new concept. In fact, AI solutions are improving security in several business sectors, including retail and finance. By tracking card usage and access to endpoints, security professionals prevent fraud more effectively. Organizations rely on AI to track these steps by analysing transaction behaviour. Companies like MasterCard and RBS WorldPay have relied on AI and deep learning to detect fraudulent transaction patterns and prevent card fraud for years[6].

2.10. Artificial intelligence in creativity

Has anyone thought about what would happen if an artificially intelligent machine tried to create music and art? An AI-based system called "MuseNet" can now compose classical music that echoes classical legends Bach and Mozart. "MuseNet" is a deep neural network that can generate 4-minute musical compositions with 10 different instruments and can combine styles from Mozart to the Beatles. Another creative product of artificial intelligence is a content automation tool – "Wordsmith". It is a natural language generation platform that can transform provided information into insightful narratives. Artificial intelligence is revolutionizing industries with its applications and helping to solve complex problems[7].

3. Advantages and disadvantages of artificial intelligence

3.1. Advantages

Artificial intelligence is one of the emerging technologies that attempts to simulate human reasoning in AI systems. The advantages of artificial intelligence applications are comprehensive, so only some of them will be discussed in the article:

– **Artificial intelligence leads to process automation**

Artificial intelligence allows robots to develop repetitive, routine and optimizing tasks automatically and without human intervention. In banks, for example,

document checks are often performed to obtain credit, which is a repetitive task for the employee. Using "AI cognitive automation", the employee could speed up the document verification process, which would benefit both customers and employees.

– **Reducing human errors**

Artificial intelligence reduces failures caused by human errors. In some production lines, through infrared sensors, AI is used to detect small cracks or defects in parts that are not detectable by the human eye. Artificial intelligence can also be helpful in risky situations such as defusing a bomb, exploring the deepest parts of the oceans, mining coal and oil.

– **Artificial intelligence could be an excellent employee**

The average person works between 4 – 8 hours a day. People need rest, food, before preparing for a new workday. With the assistance of artificial intelligence, machines can work without rest. Artificial intelligence also provides precision work, not only increasing productivity at the machine level, but also making workers more productive and increasing the quality of work they do.

– **Artificial intelligence provides digital assistance**

Some of the highly advanced organizations use digital assistants to interact with users, which saves the need for human resources. Digital assistants are used in websites to provide information that users are looking for. Some chat bots are designed in such a way that it is difficult to determine whether the conversation is with a real person or not. By using AI, organizations can set up a "Voice Bot" or "Chatbot" to help customers with various queries on their part.

– **Artificial intelligence in everyday applications**

Applications such as Apple's Siri are often used in everyday life, whether it's to search for a location, make a phone call or reply to an email. When a person would like to obtain information about a location, they could directly use "Google" to perform the search and "Google maps" will identify the location searched.

Artificial intelligence is becoming a very important resource for businesses as it allows them to be much more competitive in the marketplace against other business entities.

3.2. Disadvantages

The use of AI also poses several risks, especially if the potential of AI is explored and not limited to replicating human tasks.

Some of the most common drawbacks of enterprise deployments of AI include the following:

– **Unemployment in certain industries**

As AI replaces most of the repetitive tasks and other duties of employees, human intervention becomes less and less, which will lead to a major problem in employment standards. Some businesses are attempting to replace low-skilled workers with artificial intelligence robots that can perform similar work with greater efficiency.

– **Lack of thought process**

Machines can only perform those tasks they are designed or programmed to do. They malfunction, cause systems to crash, and provide results that are inaccurate or misleading.

– **Lack of emotion**

There is no doubt that machines are much better when it comes to working efficiently, but they cannot replace the human connection that teamwork provides. Machines cannot create professional relationships with people, which is important when managing a team of employees.

– **High set-up costs**

Since AI is updated every day, hardware and software must be updated periodically to meet the latest requirements. Machines need repair and maintenance, which requires a lot of cost for enterprises.

– **Artificial intelligence makes people less employable**

The presence of artificial intelligence is a prerequisite for people to be lazier using their applications that automate most of their work. Society tends to become addicted to these applications, which could create a problem for future generations.

4. Protection of the results of the artificial intelligence as inventions

An "invention" is most often understood as a novelty created in the field of science and technology. In order to be defined as an invention, the obtained intellectual product must necessarily be a technical solution to a problem, and the task can be in any field of the public economy. The important thing here is that not the task itself, but that its solution must be of a technical nature. If intellectual work is not a technical solution, as a rule it is not considered an invention and no patent protection for invention can be obtained. (Borisov and Borisova 2015). Intellectual efforts contribute to economic performance (Strijlev 2019).

In order to be granted a patent for an invention, the invention must meet cumulatively the three criteria for patentability specified in the law – novelty, inventive step and industrial applicability. The protection document which is issued by the Patent Office of the Republic of Bulgaria after a successful patenting procedure is called a patent. A patent for an invention could also be granted for methods, processes, technologies, chemical compounds (chemically derived substances) and biotechnological inventions (Todorova 2020). Once the patent is granted, its owner obtains exclusive rights to the patentable invention, which include the right to use the invention (manufacture, trade, offer for sale, etc.), the right of disposition (to grant licenses or to sell it to another person), and a prohibition on other persons from using the invention without the consent of the patentee. The rightholder receives income from the use of his intellectual property (Strizhlev 2020). Thus, on the one hand, the inventor's interest is protected, for

access to innovation, for the development of innovative production, and on the other hand, public goods are created for mass consumption. In order to realize an intellectual project, it is necessary first of all to be competitive (Krushkov 2020). If a company would like to be successful, it must rely on creating and refining a strategy for managing its intellectual property (Aleksandrov 2022). Innovation and intellectual property management are the backbone of business (Stoyanova 2023).

The term of the invention's protection is twenty years from the date of filing the patent application. After the expiration of this term, the patent for invention becomes publicly available and the patent owner is not entitled to exercise his exclusive rights. The patent for invention has a territorial effect – it operates in the territory of the state in which it is issued (Petrova 2020).

Inventions related to artificial intelligence are growing, moving from theory to commercial application. Since the introduction of artificial intelligence in the 1950s, innovators and researchers have applied for nearly 340,000 AI-related inventions and published over 1.6 million scientific papers. AI-related patents not only disclose AI techniques and applications, but often also relate to an application area or industry.

LG Electronics Inc. and IBM are leaders in AI patenting in various AI-related fields. In some areas, the largest number of patent applications come from companies with a high degree of specialization and expertise in this field, such as Baidu, Tencent, Microsoft, and Samsung. IP has an indispensable importance in the technological age that we live in (Konstantinov, 2022).

5. Methodology of patent research in the field of artificial intelligence

In the present article patent research will be performed for patent applications and patents granted for inventions according to the methodology for conducting patent studies set by Prof. B. Borisov in "Methodology for patent research", Sofia, UNWE, 1999.

Determining the parameters of the patent research

– Purpose of the patent research

The purpose of the present patent research is to establish the patent applications and the patents granted for inventions in the field of "artificial intelligence" in the international aspect.

– Subject of patent research

The subject of the patent research are patent applications and granted patents for inventions in the field of AI, filed with the Patent Office of the Republic of Bulgaria (BPO), the European Patent Office (EPO), the World Intellectual Property Organization, the Chinese Patent Office, The United States Patent Office (USPTO), and the South Korean Office. The scope of the patent research has been expanded outside the territory of Bulgaria, in view of the small number of

applications in the field of artificial intelligence filed by Bulgarian applicants under the national procedure before the Bulgarian Patent Office.

– *Countries to be surveyed*

The territories covered by the patent research are Bulgaria, China, USA, South Korea, international PCT applications for inventions filed at WIPO and European patent applications filed at the European Patent Office. The countries for which the study was carried out were chosen by the author due to the low number of results found for the territory of Bulgaria and the fact that these territories have the highest number of invention applications filed and patents granted in the field of artificial intelligence.

– *Depth (retrospective) of the patent research*

The patent research covers the period from 01 January 2004 to 01 January 2024 or a total of 20 (twenty) years.

– *Information sources*

The following online databases have been used to carry out this patent research:

– The online database of the Patent Office of the Republic of Bulgaria – www.bpo.bg;

– The online database of the European Patent Office – www.epo.org (European Patent Register);

– The Espacenet online database – a database coordinated by the EPO in close cooperation with the EPO Member States. More than 110 million patent documents are available worldwide - www.worldwide.espacenet.com;

– Lens online database (www.lens.org) – this database provides access to more than 117 million patent documents in over 95 jurisdictions.

In this article, only filed applications for inventions and granted patents in the field of artificial intelligence that are published in publicly accessible online patent databases are discussed.

– *Classification of the subject of patent research*

Regarding the analyzed results of filed patent applications and granted patents in the field of artificial intelligence, it should be emphasized that not all patent applications related to artificial intelligence (AI) can be classified in the same section of the International Patent Classification (IPC), so this study will not focus on a specific section of the IPC.

6. Results from the performed patent research and analysis of the information

Statistics of patent applications filed, and patents granted for inventions in the field of artificial intelligence for the period from January 01, 2004, to January 01, 2024.

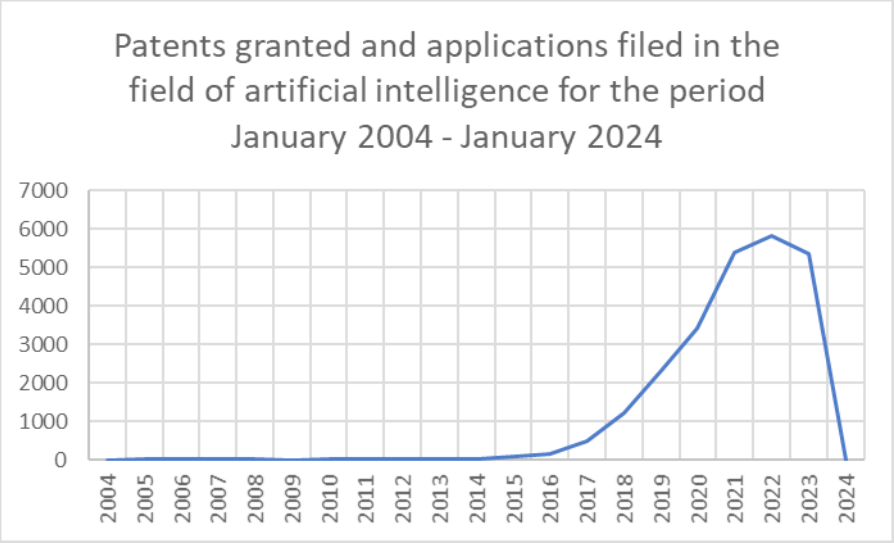

Figure 1. Granted Patent and Patent Applications shows a quantitative trend in the subject of AI by years

Source: calculations based on the results of completed patent research in online databases –www.lens.org

For 2004 no results were found, for 2005 the results increased to 23 and in 2006 there were 27. For the period 2007 – 20014, there have been no major changes in applicant activity and the results obtained have averaged between 10 – 40 documents. For 2015, the number of patent applications filed was 84 and in 2016 it was 157. In the following years there is an active increase in the application activity, namely for 2017 there are 514 results obtained, for 2018 – 1225, for 2019 – 2326 results, for 2020 the results found are 3444 and for 2021 – 5398. They reach their peak in 2022 with 5848 results found and in 2023 with 5351. Considering the research results, we could conclude that since 2017 we have seen a rapid increase in the applicant activity.

The ratio between invention applications filed and patents granted in the field of AI for the period January 2004 – January 2024 is shown in Figure 2.

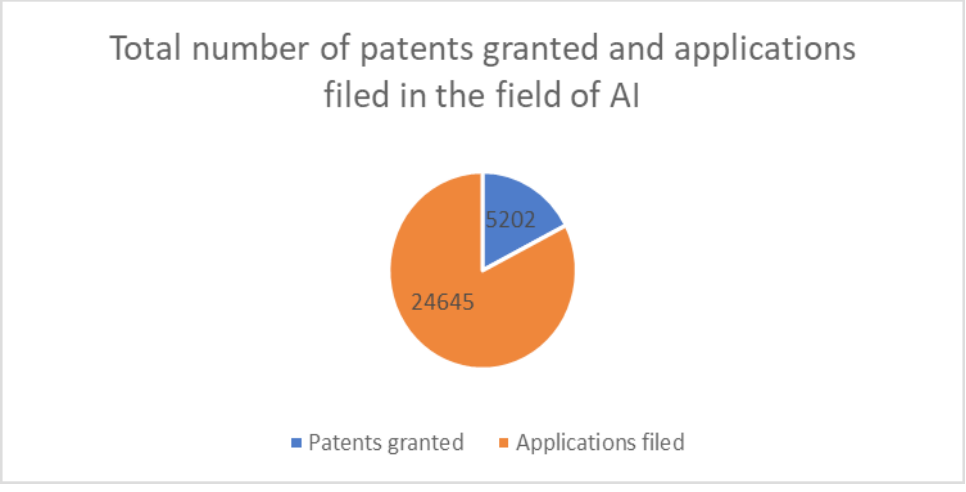

Figure 2. Patent applications filed and patents granted between January 2004 and January 2024.
Source: According to online databases – www.lens.org

Considering the results of the table below, China has the highest number of invention applications filed and patents granted in the field of artificial intelligence with 14226 results found. Second to China in the ranking is the USA with a total of 6,425 invention applications filed and patents granted. In third place is South Korea with 6,039 results, followed by WIPO with 2,275 international PCT applications filed, and in fifth place is the European Patent Office with a total of 882 applications filed and patents granted. Only one published result was found for the territory of Bulgaria. It should be borne in mind that the most likely reason for the one result found is not only the low application activity, but also the fact that some of the patent applications filed have recently been filed and have not been published yet in the available databases. Bulgaria's economic situation and the fact that it is considered one of the poorest countries in the European Union is also of importance (Tsankova 2020). In terms of GDP per capita in purchasing power parity terms, Bulgaria is one of the lagging economies and is far from the EU average. On this indicator, we are ranked last 27th in the EU. Also considering the GDP at market prices indicator, Bulgaria is again in last place in the Union, adding, and the amount of direct investment in the economy (as a percentage of GDP) we occupy only 20th position (Nachev 2022).

Table 1. Total number of applications filed, and patents issued for inventions by Country / Patent Office

Country / Patent Office	Total number of applications filed and patents issued
China	14226
USA	6425
South Korea	6039
WIPO	2275
European Patent Office (EPO)	882
Bulgaria	1

Source: According to data of patent offices and online databases – www.lens.org, www.bpo.bg

Figure 3 below shows the applicants with the highest number of patent applications filed and patents granted in the field of artificial intelligence. According to the results of the table, the companies with the highest filing activity are Lg Electronics Inc, IBM, Ping an Tech Shenzhen Co Ltd, Tencent and Samsung Electronics Co Ltd.

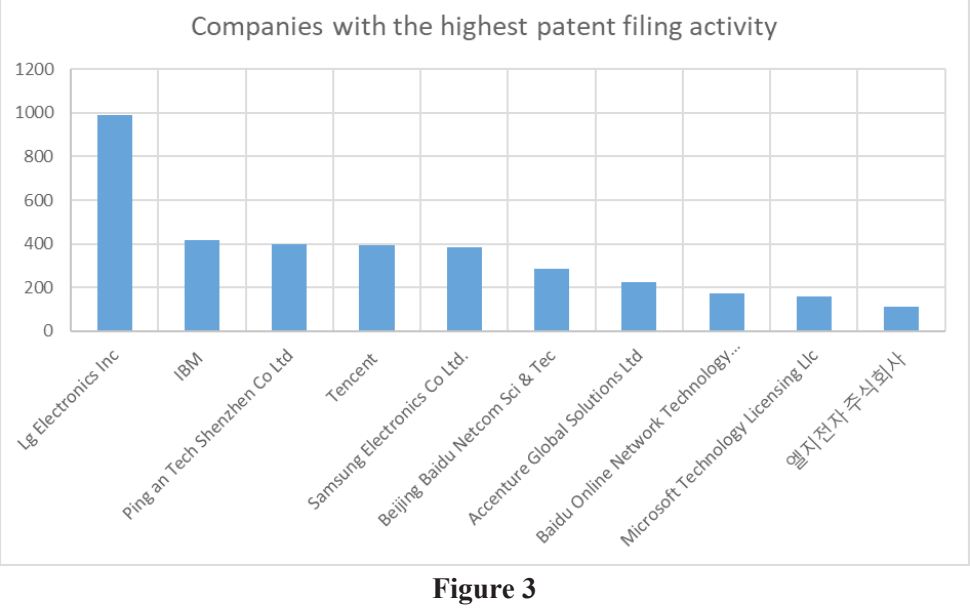

Figure 3

Source: calculations based on results of completed patent searches in online databases – www.lens.org

7. Summary and recommendations of the patent research

After analyzing the results of the research carried out, we can conclude that the application activity of companies in the field of artificial intelligence is low for the period 2004-2016. Since 2017, there has been a significant increase in the number of patent applications filed and patents granted, reaching a peak in 2022, for which there are a total of 5848 results found.

When analyzing the results of the study carried out on the applications filed and patents granted in the field of artificial intelligence, the first place is China with 14226 results published, and the second position is the United States with a total of 6425 invention applications filed and patents granted. Between the top two countries, there is a very large difference, with China having a lead over the other territories surveyed.

In view of the single result found for the territory of Bulgaria, we could conclude that artificial intelligence is definitely not of interest to Bulgarian applicants, despite its growing importance internationally. Bulgarian enterprises do not invest in the creation of innovative products in the field of artificial intelligence that can be protected by a patent for invention. They should focus on patent protection, given the importance of the intellectual property system in the modern economy is constantly growing (Papagalska 2022). It would be good for them to invest more in R&D and in creating developments in the field of AI, given the global prosperity of this field. At the same time, there are a number of Bulgarian enterprises that freely use foreign inventions that have not received patent protection for the territory of Bulgaria or use patented inventions from foreign companies for which they have obtained licences.

Conclusion

The creation of technological developments in the field of artificial intelligence that obtain protection through a patent for invention contribute to building a successful business strategy by companies and gaining a competitive advantage over other market players at national and global level. Unfortunately, the protection of innovative products in the field of AI as inventions is not a priority for most Bulgarian companies. Industrial property objects provide a number of advantages for their owners and a high return on investments made in the development of technological developments in the field of artificial intelligence. In the future, artificial intelligence will find even greater application globally, with the areas in which the technology is used growing year by year. Artificial intelligence is also having a major impact on intellectual property rights. AI legislation should ensure that intellectual property regimes are adapted in a way that allows fair protection for patent owners.

NOTES

1. www.simplilearn.com/.
2. Ibid.
3. Ibid.
4. www.edureka.com.
5. Ibid.
6. Ibid.
7. Ibid.

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