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Robotization and artificial intelligence in the function of Industry 4.0

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Abstract: This research paper will present how advances in robotics and artificial intelligence affect economic and social transformation. Based on the review of the latest literature and research conducted in practice, the relationship between artificial intelligence (AI) and robots will be evolved due to rapid technological development and the increasing application of methods, techniques and tools of artificial intelligence in various spheres of life and work. Starting with a clear definition and tracing the evolution of artificial intelligence in robotics, the paper will highlight its role, importance and application in various fields. Studies show that artificial intelligence and robotics offer great opportunities for improving life and work, improving efficiency and precision, reducing costs, errors, etc. In this context, this research study presents a critical assessment of the application of the phenomenon of artificial intelligence and robots, based on successive studies of relevant literature, evaluating artificial intelligence and robots, their development, characteristic forms and application in everyday life. Due to their capabilities, robots with elements of artificial intelligence have successfully replaced humans in performing many difficult and physically demanding and dangerous jobs, as well as in mentally simple and repetitive activities, which certainly justifies their humane application. Practice indicates that the process of implementing artificial intelligence and robots requires an adequate ICT infrastructure, followed by specialized training of key users, as well as compliance with all ethical rules of use. Research results indicate that robotics and artificial intelligence have become key players in the transformation of the world, opening the door to new ways of working and optimizing existing business processes. In this sense, the application of artificial intelligence and robots opens the door to new technological innovations and potential opportunities for the improvement of the product and service sectors. Considering the topicality of the topic, there are still insufficient studies dealing with the application of artificial intelligence (AI) in robotics by researching the integration, progress and implications of intelligent robotic systems based on artificial intelligence. Practice shows that in addition to all the benefits, one should be extremely careful and not ignore the criticism of experts in this field about the exponential development of robotics and artificial intelligence and the present fear that robots will one day become a threat to human society.

Keywords: Digitization, Industry 4.0, Robots, Artificial Intelligence.

1 INTRODUCTION (Introductory remarks)

It is known that artificial intelligence (AI) and robotics are digital technologies that will have an increasingly significant impact on the development of humanity in the near future. Many experts emphasize that one of the main drivers of humanity's progress is industry 4.0, and robotics based on artificial intelligence is the main driver of the current industrial revolution (Denić N 2024). The results of research in practice indicate that robots have become an irreplaceable factor in modern industrial production, and that many countries have based their economic progress on their development and application. The situation is similar in our environment, where the continuation of digitization and the development of robotics and artificial intelligence are among the five priority goals in the Republic of Serbia (Stojanović J.. 2024). Some authors emphasize that artificial intelligence is the ability of a computer or a computer-controlled robot to perform tasks that are usually associated with intelligent beings, i.e. artificial intelligence is defined as the use of computers and related equipment to control a machine in the way humans would (Richards & Smart , 2013). Many countries in their programs list the development of artificial intelligence and robotics as one of the priorities in the development of modern technologies (Stojanović K 2024). The literature states that a robot is essentially a actuator with two or more programmable axes and some degree of autonomy that can move in its environment to perform predetermined tasks. The branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, processing of sensory feedback, and general information processing is called robotics. In this regard, many countries apply, develop and implement artificial intelligence in robotics, which will contribute to economic growth, employment and a better quality of life for all citizens. It is known that the basics of artificial intelligence are machine learning, deep learning and neural networks, which lay the foundation for understanding how artificial intelligence improves robotic capabilities by integrating sensors and advanced algorithms for decision-making needs. In this context, fundamental questions are raised about what we should do with these new sophisticated technologies, what specifically the robotic systems based on artificial intelligence should do, what risks they involve and how we can control them. Another aspect that we find in the review of literature and research in practice indicates that investments in the application of AI in robotics significantly increase the consumption of renewable energy. Research also indicates that the use of industrial robots has a detrimental effect on the consumption of electricity obtained from renewable sources. Below are some of the different types of robots powered by artificial intelligence, such as industrial robots, service robots, autonomous vehicles, and drones, to showcase the versatility of the technology. Also, in such studies, one must talk about challenges and ethical considerations, that is, critical analysis, dealing with bias, and concern for the fairness and safety of the use of AI and robots.

2 DEVELOPMENT OF ROBOTS AND CHARACTERISTICS OF ROBOTS

The relevant literature states that robotics includes the design, construction and programming of physical robots, with the partial participation of artificial intelligence. Robotics and AI can therefore be seen as covering two overlapping sets of systems: AI-only systems, robotics-only systems, and systems that are both. It is of interest to the research to take into account all three factors, in this sense, not only the intersection is important for consideration, but also the union of both of these sets, which is presented in the following figure 1. (Balajee, 2020).

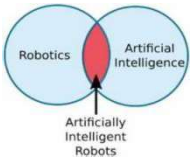

Figure 1 Venn diagram of robotics and AI (Izvor Darapuredu... 2021)

It is known that robotics entered the big door when the industrial revolution brought many significant changes for people, considering that with its appearance, the efficiency and effectiveness of production increases significantly. In this context in industry, in robotics, one part of artificial intelligence is used to automate processes that are physically demanding and repetitive, where practice shows that machines can do it with greater precision and give better results. Studies show that artificial intelligence is created when a human is replaced by a system in the performance of complex tasks, which will continue to work and communicate with others, without anyone noticing that the human has been replaced by a robot. Based on the literature and experience in practice, it is concluded that in addition to the application of robots in industry today, they are applied in all areas of human activity, based on the principle that the simpler the task, the faster we will train the robot to perform it. They help man to build faster, when putting out fires or transporting the wounded in war. The development of artificial intelligence and its integration into robot control systems expands our possibilities of their application, including areas where robots have not been applied so far. Based on the above facts, it is necessary for states to take these statements into account and invite investors to invest in the development of artificial intelligence models and robots in order to reduce their negative impact on the environment and sustainable development.

2.1 Robot evolution

In the literature, it is stated that the word robot comes from the Slavic word "robota", which means work, worker. The term robotics appears for the first time in the short science fiction story "The Liar" by Isaac Asimov. In this context, it is said that the word robot was first used by the Czech writer Karel Čapek in the play R.U.R. – Rossum's Universal Robots in 1920, in the context of the characters in the play who were mass-produced workers, incapable of creative thinking (Daley, 2022). The action of this drama begins in a factory that produces artificial humans - robots, similar to today's idea of androids. Some authors point out that in the end, whatever they look like, all robots have three key elements that define them (Zuhlke, 2022): sensors, control systems and a program. From an evolutionary point of view, robots have become smaller and more useful over time, so that today they are almost irreplaceable in many areas and critical situations in business and industry. According to the mentioned author, we can say that the robot performs certain tasks autonomously (Zuhlke, 2022). Authors like Sam Daley (2022) emphasize that, despite the extraordinary expansion and development of robotics, robots still have some general universal characteristics in common, namely that they are all more or less composed of some mechanical parts. The facts show that it was the industrial revolution and the invention of electricity that enabled the use of more complex mechanical parts and thus significantly accelerated the development of robotics as a science. Some authors emphasize that it is very important to emphasize that from the very beginning of designing robots, their creators face the challenge of how the robots should behave. In this sense, solutions should be provided to the questions of how to train robots to perform complex tasks, and at the same time enable intelligent interaction with the environment in which they function. Well-known authors state that in this regard there are two most commonly used strategies with completely opposite approaches (Bakker & Kuniyoshi, 1996):

1. Program the robot down to the smallest detail so that it knows what to do.
2. Provide the robot with a simple learning strategy and allow it to find on its own through interactions how it should react to the environment.

Chronologically observed in the literature, the first invention or innovation that had and still has a great influence on the development of robots is attributed to Leonardo da Vinci. Leonardo's mechanical knight is the first documented humanoid automaton, designed by him in 1495. In this regard, the sketches found in Leonardo's notebook are extremely significant, together with the sketches of mechanical birds and insects that the author designed in an attempt to imitate nature. As usual, this invention did not go beyond the sketches, however, later others realized his designs to prove that the design really works. It was this famous scientist and versatile artist who in 1478 invented the first powered cart, shown in the following picture 2. (Tech Target Contributor, 2021).

Figure 2 Leonard's stroller

Reviewing the available literature, it is not entirely clear whether Leonardo managed to complete his robot-knight project, but recent reconstructions have shown that the robot was completed and functional according to the blueprint. Regarding the laws of robotics themselves, the following three laws of robotics are generally used (Kaminka, Spokoini, Amir, & Agmon, 2017):

1. The first law of robotics: A robot must not injure a human being or, through its inactivity, allow a human being to be injured.
2. The Second Law of Robotics: A robot must obey the orders of human beings, unless those orders conflict with the First Law.
3. The Third Law of Robotics: A robot must protect its own existence, unless it conflicts with the First and Second Laws

It is known that the first industrial robot in the world is Unimate, which was installed on the assembly line in the General Motors factory in 1961. In our country, Professor Rajko Tomović developed the first prosthetic hand with five fingers in the world in 1963 at the Mihajlo Pupin Institute, the hand had touch sensors, and its grasping capabilities were comparable to today's. As for the classification of robots itself, the World Federation of Robotics (IFR) classifies professional/commercial service robots in twelve categories based on the definitions of various terms in ISO standards, but it is noticeable that there is

no clearer definition of "professional" and "commercial". One of the characteristic classifications of robots is presented below. (Source Darapuredu... 2021)

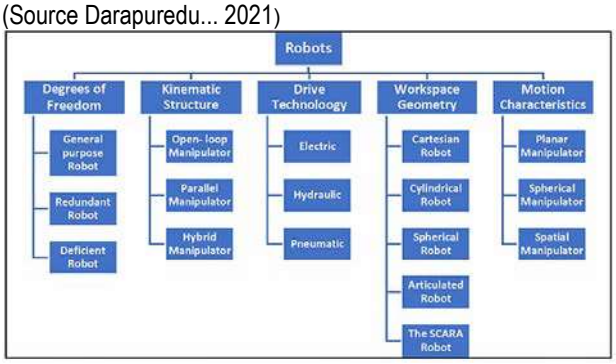

Figure 3. Classification of robots (Izvor Darapuredu... 2021)

It is also noticeable that lately there is more and more talk about the introduction of robotics and artificial intelligence into the education process through learning tools. In many cases, robots in schools can also be assistants that help teachers in the teaching process (EUBusinessSchool, 2022). One of the first divisions of robots is related to the environment in which they function. A representation of the different types of robots according to this criterion can be seen in Figure 4. (Ben-Ari & Mondada, 2018)

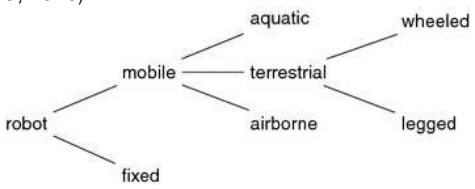

Figure 4 Types of robots according to the environment in which they work

Source: (Ben-Ari & Mondada, 2018)

According to these authors, if we divide robots according to the environment in which they work, we can first divide them into mobile and fixed robots. The literature states that the two biggest challenges in robotics are costs and development complexity. It is also pointed out that robots can be divided according to the intended area of application and the tasks they perform. This division is shown in the following figure 5.

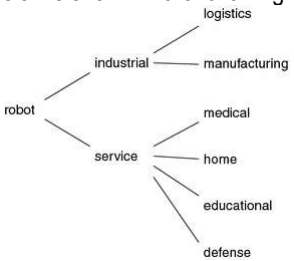

Figure 5 Tipovi robota prema njihovoj funkciji

Izvor: (Ben-Ari & Mondada, 2018)

3. APPLICATION OF ROBOTS IN PRACTICE

One of the situations that significantly affected the use of robots was the pandemic caused by the COVID 19 virus, when in 2020 robots, since they were not sensitive to viral infections, were able to take on a task that was potentially too dangerous for humans to perform. (Hearn, 2020). Well-known authors indicate that it was then that robots became part of a multi-layered response to the crisis and after the pandemic remained as a widespread and even everyday infrastructure (Dempsey, 2022). Other authors also emphasize that when planning the path of the robot, it takes into account the presence of people and their intentions if they are near it, which ensures that the robot maintains a safe distance from all people, as well as moves in a way that allows it to be in the field of view. people and not to surprise them when he approaches them (Shneier & Bostelman, 2015). Research shows that today robots enable further and more flexible automation of processes, and that in this sense jobs that require more intelligence, knowledge and creativity remain for humans, so it can be said that in this sense, robotic systems contribute simultaneously to increasing productivity and humanizing work. Another need for robots led to the development of robots of a different form, known as mobile robots. These robots replace humans in performing tasks in difficult conditions and dangerous areas. In terms of the actuality of robotics itself, the fact that the size of the global professional service robots market is estimated at USD 33.44 billion in 2023 and is projected to grow at a compound annual growth rate (CAGR) of 11.3% from 2024 to 2030. The following figure 6 presents the global professional service robots market value prediction.

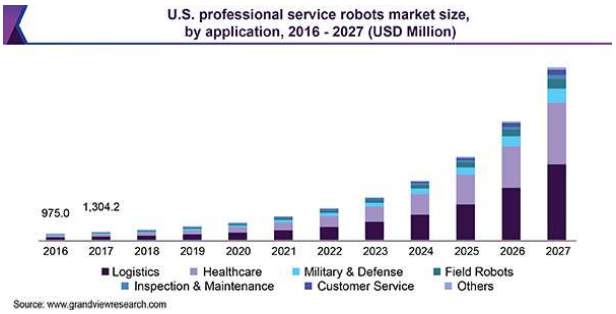

Figure 6 The global professional service robots market value prediction (Source: Coherent Market Insights)

In this context, according to a report published by the International Federation of Robotics (IFR), sales of service robots for professional applications will increase by 48% in 2022, reaching 158,000 units, with agriculture, hospitality, professional cleaning and logistics showing a steady increase in demand for these solutions. For example, in the transport and logistics segment, robot sales increased by 44%, with more robots designed to transport cargo and goods. Here in the Republic of Serbia, artificial intelligence is most developed in the field of industry and agriculture. Worldwide, in the agricultural sector, sales reached around 8,000 units, which is an 18% increase compared to the previous year. Of these, around 75% of robots were used in agricultural tasks such as cleaning agricultural buildings and milking cows, sheep, etc., highlighting the growing preference of agricultural and farm owners to optimize their productivity while minimizing labor costs and mitigating the environmental impact of modern agricultural practices. . Research also shows that by applying intelligent data processing in agriculture, different estimates can be obtained, from what the yield will be to how to increase it. In addition to the mentioned examples of application in agriculture, some authors emphasize that robots can defuse bombs, collect data on the edge of volcanic craters, transfer hazardous materials, explore the ocean floor and perform various research or maintenance tasks in space (Hagis, 2003). The following figure 7 presents the Global robotics market

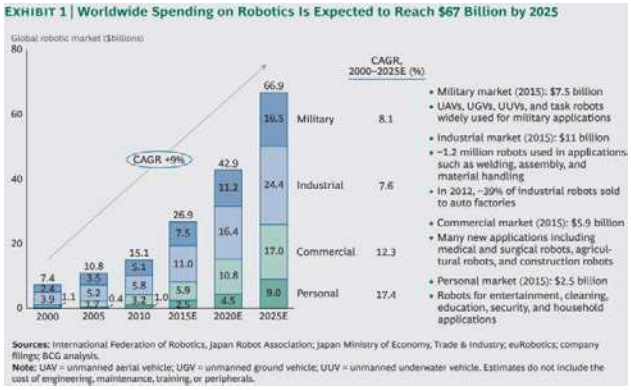

Figure 7 Global robotics market (Source: International Federation of Robotics; Japan Ministry of Economy; Trade & Industry; euRobotics; company fillings; BCG analisys)

The pandemic situation provided an opportunity to explore the possibilities of robotic and autonomous systems that can provide cities with the resources to deal with unexpected situations such as emergencies, weather disasters, pandemics, heat waves and blizzards and ultimately to transform and strengthen urban flows, which it leads to new ways of organizing and planning life in the city that arise as a result of the emergence of constellations of man and robot. The crisis accelerated the ongoing transformation of non-human-robot relations and made visible all its tensions and potentials. The research results indicate that the cognitive abilities of urban artificial intelligence cannot be found exclusively in computer bits and human neurons, but arise from encounters and contexts, with institutions, policies, practices, and even the materiality of the city itself, which are key to the emergence of urban AI. In the strategy of the government of the Republic of Serbia, the underdeveloped startup ecosystem, a small number of researchers in the field of AI, weak support for the private sector in the development of artificial intelligence, as well as insufficient cooperation between science and business, and above all cooperation, are highlighted as key problems for the use of AI in Serbia technical faculties with economy.

4 RESEARCH METHODOLOGY

Among other things, this work uses the study of literature as a method. In this sense, the descriptive method is used in the part of the work on artificial intelligence and robots. The connection of these areas with human lives and their development until today was investigated, with the help of reading electronic sources and summarizing them, using the chronological method, then the compilation method, the descriptive method, and finally the synthetic method.

5.CHALLENGES AND PARADIGMS OF ROBOT APPLICATION

Some authors emphasize that it is great that robots will do all the bad, difficult, dirty and dangerous jobs instead of us, but the question arises, do the people who do those jobs want that too (Ceurstemont, 2019). In this sense, well-known authors emphasize that urban robots, as well as other urban systems that rely on networked computing, are subject to failures, as well as forms of vandalism, disruption and criminal exploitation that risk making urban infrastructure insecure and fragile (Kitchin and Dodge, 2019). This is followed by OSHA (US Agency for Occupational Safety and Health) identifying 7 possible hazards within robot work zones (Hogg, 2011): 1. Human errors 2. Control system errors 3. Unauthorized access 4. Mechanical failure 5. External factors 6. System power and 7. Improper installation. New generations of smart robots, or smart technical systems in general, are turning to new applications, especially in service activities, medicine and home use, although there are certain limitations in this process. In this context, some authors emphasize that robots have the potential to stimulate innovation, improve access and provide data for improved decision-making, but there is also a risk that they will reproduce and automate inequality or result in a more fragmented and unclear urban governance (Guenat et al., 2022). . Also notable are opinions that the impact of robots was often limited in scope and reliability when pushed to their limits in crisis scenarios (Wang et al., 2021). Well-known authors emphasize that although people have been dreaming about robotic assistants for decades, the robotic vacuum cleaner is one of the first to be developed to the extent that we can use it in practice (Hendriks, Meerbeek, Boes, Pauws, & Sonneveld, 2010). The following figure8 shows the application of robots in industry.

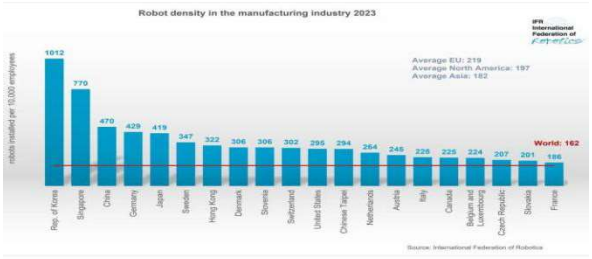

Figure 8 Robot density in manufacturing industry, 2023. (Source: World Robotics 2024)

It is known that AI can be entirely software, while robots are physical machines that move. In this regard, robots are susceptible to physical impact, usually via "sensors", and exert physical force on the world, usually via "activators", such as a gripper or a turning wheel. Accordingly, we can say that autonomous cars or airplanes are robots, while only a small part of robots is "humanoid". It is important to emphasize that in the future, autonomous and mobile robots will be able to help elderly and immobile people, help with household chores, act as caregivers and perform repetitive, boring or dangerous tasks in nursing homes, hospitals, military environments, disaster sites and schools, among other things. Practice shows that some robots use AI and some do not: Typical industrial robots blindly follow fully defined scripts with minimal sensory input and no learning or reasoning (around 500,000 such new industrial robots are installed every year (IFR 2019 [OIR]). It's probably fair to say that while robotic systems are of more concern to the general public, artificial intelligence systems of intelligence and their application to robotics are more likely to have a greater impact on humanity. Also, AI or robotic systems for a narrow set of tasks are less likely to cause new problems than systems that are more flexible and autonomous. As noted by Lin (2022), the pandemic caused by the COVID-19 virus has accelerated the exploration of a new form of advanced technologies with the potential to achieve more resilient but also less inclusive urban flows. Forbes states that precisely by using the power of advanced technologies and artificial intelligence, countries such as Serbia, Greece, the United Arab Emirates and Israel have managed to establish an optimized and efficient framework for the distribution of vaccines. Although robots possessed only narrow intelligence based on repetition and separation, they benefited from their ability to connect data and coordinate

action, as well as from a logic based on adapting to real-time changes in urban flows that can usefully be described as smart (Kitchin and Dodge 2019) or cybernetic. As one of the examples of the use of artificial intelligence in the suppression of the corona virus pandemic, the reports of world organizations mention decoding the structure of the virus and understanding how it attacks cells in the body, discovering drugs to alleviate or treat the disease, predicting the locations of the next hotspots, and the development of advanced health system resources.

CONCLUSION

In this paper, we take an optimistic view of the transformative potential of the application of artificial intelligence in robotics, emphasizing the need for an ethical approach to application while respecting the standards of environmental protection and sustainable development. Studies show that artificial intelligence facilitates and improves people's lives in various fields. However, robots combined with artificial intelligence can make life easier in many situations. The results of the research indicate that robots have played an important role in society, business and production and that they have changed the production economy during the last ten years. The robot must be controlled by a system that we want to be as efficient and independent as possible, which is why artificial intelligence would be the perfect control center for a robot. Research in practice indicates that systems with artificial intelligence are developing more and more every year. In addition, robots, thanks to the continuous development and advancement of technology, are becoming capable of imitating humans in some situations, which is why we are increasingly including them in our daily lives to help us. In the process of development and application of AI, not only in robotics, there are numerous pitfalls that should be avoided already in the development phase and that we must pay attention to, because the consequences of some of these problems could be catastrophic. It is obvious that a studious analysis of the future trends and development of artificial intelligence and robots represents the application of innovative methods of technologies and approaches, through the prospects for progress and the expected impact on industry and society. Research results indicate that it is recommended that systems based on artificial intelligence or robots be thoroughly tested in safe environments before being used in practice, where we can react even if something goes wrong. Based on the research conducted, it is obvious that humanoid robots with artificial intelligence will be a part of everyday life in the future. It is recommended that future research should be conducted from the point of view of both ethics and business on the points that should be taken into account when introducing robots with elements of artificial intelligence in business. The results also point to some negative connotations of the application of AI in robotics, such as the fact that the use of robots can lead to reduced contact between people and possible restrictions on personal freedoms. Finally, this research lays a critical foundation for future research and thus the paper can be considered to have fulfilled a certain role.

REFERENCES

[1]Bakker, P., & Kuniyoshi, Y. (1996). Robot see, robot do: An overview of robot imitation. Pronadjeno na:https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.27.292&re p=rep1 &type=pdf.

[2] Balajee, N. (2020). Robotics Vs. Artificial Intelligence: What is the difference? Medium. https://medium.com/@nanduribalajee/robotics-vs-artificial-intelligence-what-is-the-difference-6adad236d997

[3] Ben-Ari, M., & Mondada, F. (2018). *Elements of Robotics.* Springer Cham. doi:https://doi.org/10.1007/978-3-319-62533-1.

[4] Bessant, J., Rush, H., and Trifilova, A. (2015). Crisis-driven innovation: the case of humanitarian innovation. Int. J. Innovat. Manage. 19, 1540014. doi: 10.1142/S1363919615400149

[5] Ceurstemont, S. (17. september 2019). *Concerns linger over workplace robots, even as they deliver benefits*.Pronadjeno na European Commission:https://ec.europa.eu/research-and-innovation/en/horizonmagazine/concerns- linger-over-workplace-robots-even-they-deliverbenefits.

[6] Daley, S. (18. avgust 2022). *Robotics: What Are Robots? Robotics Definition & Uses.* Pronadjeno na BuiltIn: https://builtin.com/robotics

[7] Darapureddy, N., Kurni, M., & K., S. (2021). A Comprehensive Study on Artificial Intelligence and Robotics for Machine Intelligence.

[8] Dempsey, M. (2022). Are we falling in love with robots? BBC News. Available online at: https://www.bbc.co.uk/news/business-62007675 (accessed February 21, 2023).

[9] Denić,N., Stojanović,K.,Stojanović, J. „Possibilities of applying IoT in the municipality of Gračanica" The Book of Abstracts International Scientific and ProfessionalConference "ALFATECH"Smart Cities and modern technologies March 15, 2024, Belgrade, Serbia, 20 –20, ISBN 978-86-6461-070-4, COBISS.SR-ID 139964169, DOI:10.5281/zenodo.10802515

[10] EUBusinessSchool. (19. april 2022). *The Benefits of Robots in Education*.Pronadjeno na EU Business School: https://www.euruni.edu/blog/the-benefitsof-robots-in-education/.

[9]Guenat, S., Purnell, P., Davies, Z. G., Nawrath, M., Stringer, L. C., Babu, G., et al. (2022). Meeting sustainable development goals via robotics and autonomous systems. Nat. Commun. 13, 3559. doi: 10.1038/s41467-022-31150-5

[10]Hagis, C. (Maj 2003). HISTORY OF ROBOTS. Pronadjeno nahttps://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.100.3268 &rep=rep 1&type=pdf.

[11] Hendriks, B., Meerbeek, B., Boes, S., Pauws, S., & Sonneveld, M. (23. december 2010). Robot Vacuum Cleaner Personality and Behavior. Pronadjeno nahttps://link.springer.com/content/pdf/10.1007/s12369-010-0084-5.pdf.

[12] Hogg, S. (5. januar 2011). *7 Industrial Robotics Hazards and How to Avoid Them*. Pronadjeno na Bastian Solutions: https://www.bastiansolutions.com/blog/7- industrial-robotics-hazards-and-how-to-avoid-them/.

[13] Kaminka, G., Spokoini, R., Amir, Y., & Agmon, N. B. (1. avgust 2017). *Molecular Robots Obeying Asimov's Three Laws of Robotics*. Pridobljeno iz MIT PRess Direct: https://direct.mit.edu/artl/article/23/3/343/2889/Molecular-RobotsObeying- Asimov-s-Three-Laws-of.

[14] Kitchin, R., and Dodge, M. (2019). The (in) security of smart cities: vulnerabilities, risks, mitigation, and prevention. J. Urban Technol. 26, 47–65. doi: 10.1080/10630732.2017.1408002

[15] Lin, W. (2022). Automated infrastructure: COVID-19 and the shifting geographies of supply chain capitalism. Prog. Hum. Geogr. 46, 463–483. doi: 10.1177/03091325211038718

[16] Richards, N., & Smart, W. (10. maj 2013). How Should the Law Think About Robots? Pronadjeno na:https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2263363 .

[17] Shneier, M., & Bostelman, R. (Maj 2015). Literature Review of Mobile Robots. Pronadjeno na: https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=915942.

[18] Stojanovic,J.,Denić, N., Stojanović, K., "Transformation of E-administration into digital administration and smart cities and villages" " The Book of Abstracts International Scientific and ProfessionalConference "ALFATECH"Smart Cities and modern technologies March 15, 2024, Belgrade, Serbia, 20 – 20, ISBN 978-86-6461-070-4, COBISS.SR-ID 139964169, DOI: 10.5281/zenodo.10802515

[19] Stojanović, K.,Denić,N., Stojanović, J. "Paradigms of application of business data analysis and business intelligence in public administration and local self-government" " The Book of Abstracts International Scientific and ProfessionalConference "ALFATECH"Smart Cities and modern technologies March 15, 2024, Belgrade, Serbia, 20 – 20, ISBN 978-86-6461-070-4, COBISS.SR-ID 139964169, DOI: 10.5281/zenodo.10802515

[20]TechTargetContributor. (Maj 2021).*TechTarget*. Pronadjeno na Robot:https://www.techtarget.com/searchenterpriseai/definition/robot.[[20]Wang, R., Nakhimovich, D., Roberts, F., and Bekris, K. (2021). "Robotics as an enabler of resiliency to disasters: promises and pitfalls," in Resilience in the Digital Age (Cham, Switzerland: Springer International Publishing), p. 75–101. doi: 10.1007/978-3-030-70370-7_5

[20] World Economic Forum 2020, The Future Jobs Report, October 2020. [Online] Available at: https://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf. Accessed on May 6 2022.

[23]Zuhlke, S. (20. maj 2022). *What is a Robot?* Pronadjeno na National Geographic:https://education.nationalgeographic.org/resource/whatrobot.

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