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Doha, Qatar
26-28.09.2023

Scientific Collection
InterConf

№ 172
September, 2023

OPEN ACCESS

Scientific Collection «InterConf»

№ 172

September, 2023

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DOHA
2023

UDC 001.1

S 40 *Scientific Collection «InterConf»*, (172): with the Proceedings of the 3rd International Scientific and Practical Conference «Progressive Science and Achievements» (September 26-28, 2023; Doha, Qatar) / comp. by LLC SPC «InterConf». Doha: Katara, 2023. 255 p.

ISBN 978-9927-156-34-2 (series)

Please, cite as shown below:

1. Surname, N. & Surname, N. (2023). Title of an article. *Scientific Collection «InterConf»*, (172), 21-27. Retrieved from https://archive.interconf.center/index.php/conference-proceeding...

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Scientific Collection «InterConf» and its content are indexed in Google Scholar

Proceedings of the 3rd International
Scientific and Practical Conference
«Progressive Science and Achievements»
(September 26-28, 2023).
Doha, Qatar

No
172

GENERAL ENGINEERING AND MECHANICS

Comparative analysis of the advantages and disadvantages of collaborative robot control methods within Industry 5.0

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Industry 5.0 represents an evolution of industry in which robotics and automation focus on close collaboration between humans and robots [1]. This means that collaborative robots play a key role in Industry 5.0, and management methods must support their collaboration with humans. Analyzing publications, at this point in time there are the following methods for managing collaborative robots within Industry 5.0 [2-5]:

- programmable control: Robots can be programmed to perform various tasks. Industry 5.0 uses intuitive software tools to allow engineers and workers to customize and reprogram robots so they can interact with people and perform different tasks based on needs;
- Control using gestures and facial expressions: Collaborative robots can be equipped with systems for recognizing gestures and facial expressions. It allows operators and workers to control robots using gestures, facial expressions and voice commands;
- sensors and feedback: Robots are equipped with various sensors, such as cameras, lidars, touch sensors and others. They can use this information to detect obstacles, avoid collisions, and even respond to physical contact with a person;
- Machine Learning and Artificial Intelligence: With the advancement of machine learning and artificial intelligence, robots can learn in real time and adapt to new scenarios and tasks. They can analyze data, make decisions and optimize

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their actions depending on the context;

- safety systems: An important aspect of managing collaborative robots is ensuring the safety of workers and operators. Robots can be equipped with safety systems such as soft shells, collision sensors and emergency stop systems.

- collaboration systems: Robots can be integrated into collaboration systems, allowing operators and workers to interact with them on the job and perform tasks together.

For ease of analysis, we present the advantages and disadvantages of the above listed methods for controlling collaborative robots within Industry 5.0 in the form of Table 1.

Table 1

Comparison of the advantages and disadvantages of various methods of controlling collaborative robots [6-10]

Control method	Advantages	Flaws
Software control	- flexibility in configuration and reprogramming; - the ability to create a variety of programs; - task automation support	- programming knowledge is required; - requires time to develop and debug the program;
Control using gestures and facial expressions	- natural and intuitive interaction; - minimizes the need for operator training	- requires sensors for recognition of gestures and facial expressions; - limited set of available gestures and commands
Sensors and feedback	- allows robots to react to the environment; - obstacle detection and safe movement	- limited recognition of difficult situations; - may require complex data processing algorithms
Machine learning and artificial intelligence	- adaptation to new scenarios and conditions; - ability to optimize production processes	- requires a large amount of data for training; - not always able to explain decisions made
Collaboration systems	- the ability to work together between humans and robots; - expanding the functionality of robots in cooperation	- requires coordination between human and robot; - may require additional integration with processes

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One drawback that may be common to all methods of controlling collaborative robots is the potential dependence on technical failures. Regardless of the control method chosen, robots may be subject to technical problems, including hardware failures, software errors, network failures, and other problems. These problems can cause interruptions, reduced productivity, and in some cases even pose a safety hazard to operators and others.

In addition, the complexity of the technical solutions used in each method can also be accompanied by high costs for development, maintenance and personnel training. Implementing and maintaining robot control systems requires specialists with the appropriate knowledge and skills, as well as investment in hardware and software.

References:

[1] Pedro Coelho, Catarina Bessa, Jorge Landeck, Cristovão Silva. (2023). Industry 5.0: The Arising of a Concept. Procedia Computer Science, Volume 217, Pages 1137-1144. https://doi.org/10.1016/j.procs.2022.12.312

[2] Hameed, A.; Ordys, A.; Możaryn, J.; Sibilska-Mroziewicz, A. (2023) Control System Design and Methods for Collaborative Robots: Review. Appl. Sci., 13, 675. https://doi.org/10.3390/app13010675

[3] Prasenjit Sarkhel, Mithilesh K. Dikshit, Vimal Kumar Pathak, Kuldeep K. Saxena, C. Prakash, Dharam Buddhi. (2023). Robust deflection control and analysis of a fishing rod-type flexible robotic manipulator for collaborative robotics. Robotics and Autonomous Systems, Volume 159, 104293. https://doi.org/10.1016/j.robot.2022.104293

[4] Attar, H., & et al.. (2022). Zoomorphic Mobile Robot Development for Vertical Movement Based on the Geometrical Family Caterpillar. Computational Intelligence and Neuroscience, 2022, Article ID 3046116, https://doi.org/10.1155/2022/3046116.

[5] Nevliudov, I., Yevsieiev, V., Maksymova, S., Demska, N., Kolesnyk, K., & Miliutina, O. (2022, September). Object Recognition for a Humanoid Robot Based on a Microcontroller. In 2022 IEEE XVIII International Conference on the Perspective Technologies and Methods in MEMS Design (MEMSTECH) PP. 61-64. DOI: 10.1109/MEMSTECH55132.2022.10002906

[6] Attar, H., & et al.. (2022). Control System Development and Implementation of a CNC Laser Engraver for Environmental Use with Remote Imaging. Computational Intelligence and Neuroscience, 2022, Article ID 9140156, https://doi.org/10.1155/2022/9140156.

[7] Моделі та методи кіберфізичних виробничих систем в концепції Industry 4.0 : монографія / І. Ш. Невлюдов, В. В. Євсєєв, А. О. Андрусевич, С. С. Максимова ; – Oktan Print – Prague. 2023. – 321 с.

[8] Vladyslav Yevsieiev, Nikolaj Starodubcev (2023). Development of a control algorithm for a small-sized mobile manipulation robot. Scientific Collection «InterConf», (140), P. 648-651.