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Is True Robot Autonomy Possible? (A Philosophical Consideration)

Abstract: The paper aims to demonstrate that autonomy in action requires self-location so that it is possible to construct autonomous systems only if they are capable of self-localization. The paper briefly presents the history of the idea of humanoid robots, and then in the main part it conceptually discusses the question of the possibility of robot autonomy starting from the problem of indexicals. The paper starts from John Perry's thesis that indexicals are necessary for action, and subsequently, presents Jenann Ismael's concept of an agent representing an information system in which indexical information, for example in self-location, connects an information model with the environment. The paper points to examples of robots, such as the Figure 01 model, as systems described by Ismael, which are capable of autonomously performing actions as well as of self-locating.

Keywords: robots, autonomous action, indexicals, self-location, Figure 01 robot model

Introduction

At the beginning of 2024, some of the world's biggest technological companies announced the projects in which they intended to produce humanoid robots that would be autonomous in the true sense of the word. With its chatbot based on artificial intelligence (AI) and large language models (LLM), Company OpenAI, known for its popular Internet platform ChatGPT, began a cooperation with a smaller robotic company Figure to create an autonomous robot in a human form which is capable of performing various actions and tasks on its own.[2] Thanks to Figure and Open AI joining forces and to merging robotics and AI, the Figure 01 robot model is able to speak, draw practical conclusions, perform tasks in line with the orders formulated in a natural language,

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[2] See: https://www.figure.ai/

to notice and recognize objects and acts accordingly.[3] Big technological companies, such as Nvidia, Amazon, Microsoft and OpenAI, recognized the importance of the Figure project and invested $675 million, thus substantially increasing its value which, according to the current estimates, is $2.6 billion.[4]

The idea of humanoid robots and AI, which attracts large investments and encourages economic development in the modern world, has been the subject of considerations by thinkers, philosophers and scientists ever since ancient times. In this paper we will briefly present the history of the idea of robots and then consider the question of the potential autonomy of robots, starting from the problems of indexicals and self-location. The goal of this paper is to show that for autonomy of action, either of men or robots, self-location is necessary, so that it is possible to construct systems with autonomy only if those systems are capable of self-location.

Brief history of the idea of robots

In ancient times, the idea of humanoid machines was originally present in mythological and religious narratives. Heron of Alexandria, 1st century AD), an ancient Greek mathematician and inventor, was the first to devise practical automata outside mythology, and that is why he is considered the founder of cybernetics. His famous automata were applied in the theatre and music. In the Middle Ages, Ibn ar-Razāz al-Jazarī (1136–1206) also construed practical automata, described in *The Book of Knowledge of Ingenious Mechanical Devices* (*Kitab fi ma 'rifat al-hiyal al-handasiya*). From the beginning of the modern era, thinkers such as Leonardo da Vinci, René Descartes and Nikola Tesla were obsessed with the idea of humanoid robots (Rosheim, 1994, p. 1). Mark Rosheim introduced the term "anthrobot" for anthropomorphic robots (in old Greek, *antropos* – man, *morphe* – shape) (Rosheim, 1990, p. 2162) to determine the ideas of humanoid robots by the above-mentioned thinkers (Rosheim, 1994, p. 1).

> The research aimed at construing the humanoid robotic arm began in the 1960s, with the pioneering work of the members of "Mihajlo Pupin" Institute, professors from the Faculty of Electrical Engineering in Belgrade (Tomović, 1960; Tomović & Boni, 1962; Rakić, 1964). Namely, in 1963 they construed the first bionic hand, or adaptive prosthesis with external power supply, known as the "Belgrade Hand".

[3] See: "Figure Status Update – OpenAI Speech-to-Speech Reasoning", available at https://youtu.be/Sq1QZB5baNw?si=g_nhbZSNRWMlNVpV (Accessed on 11. 4. 2024)

[4] See: https://www.cnbc.com/2024/02/29/robot-startup-figure-valued-at-2point6-billion-by-bezos-amazon-nvidia.html (Accessed on 11. 4. 2024)

Rosheim himself construed a robotic arm which was able, in terms of mobility, to perform every task just as the real human hand (Rosheim, 1990, p. 2162). In terms of kinematics and structure, Rosheim's "omnidirectional arm" is equivalent to the human arm and, therefore, it is "anthrobotic" (Rosheim, 1990, p. 2162).

Today's robotic arm models may perform different movements and strokes in different positions, with great precision and skill. Moreover, apart from the Figure 01 robot model being able to use its arms to sort out and put dishes into a basket, to collect scattered litter and put it into a bin, to catch and give an apple, as it can be seen in the company's promotional video,[5] it can also *recognize* objects, dishes, a basket for dishes, litter, a bin, an apple, *draw conclusions* about all objects, *treat* them *practically* in an adequate manner,

Belgrade hand was constructed in 1963 by the researchers from Institute "Mihajlo Pupin", part of the collection in the Museum of Science and Technology in Belgrade.
Photo: Museum of Science and Technology

[5] See: "Figure Status Update – OpenAI Speech-to-Speech Reasoning", available at https://youtu.be/Sq1QZB5baNw?si=g_nhbZSNRWMlNVpV (Accessed on 11. 4. 2024)

determine the location of an object in relation to itself and its own location in relation to objects, act *upon general orders*, talk and *understand* the interlocutor's intention and *assess* its actions. This robot has the above-listed abilities not only thanks to the construction of robotic hands and sensors, but primarily to the neuron network models which have been trained on a sufficiently large amount of data to resolve problems autonomously. By joining robotics and machine learning technology and neural networks on which artificial intelligence relies, the idea strived for by thinkers ever since ancient times will be realized – that machines can be autonomous in their action like a human, that they can autonomously resolve problems, make decisions and perform practical tasks.

From indexicals to autonomy

According to an influential belief in modern philosophy, an individual's ability to translate his/her understanding of the world into action depends on "indexical thoughts (*indexicals*)", or thoughts in which something or someone is indicated, shown or pointed to. One of the proponents of this belief is John Perry, an American philosopher who claims that indexical expressions, such as the personal pronoun "I" and demonstrative pronouns ("this", "that", "here", "there"), are indispensable and irreplaceable in indexicals. If we replaced indexical expressions in indexicals by descriptive terms, we would get an inadequate explanation of behaviour.

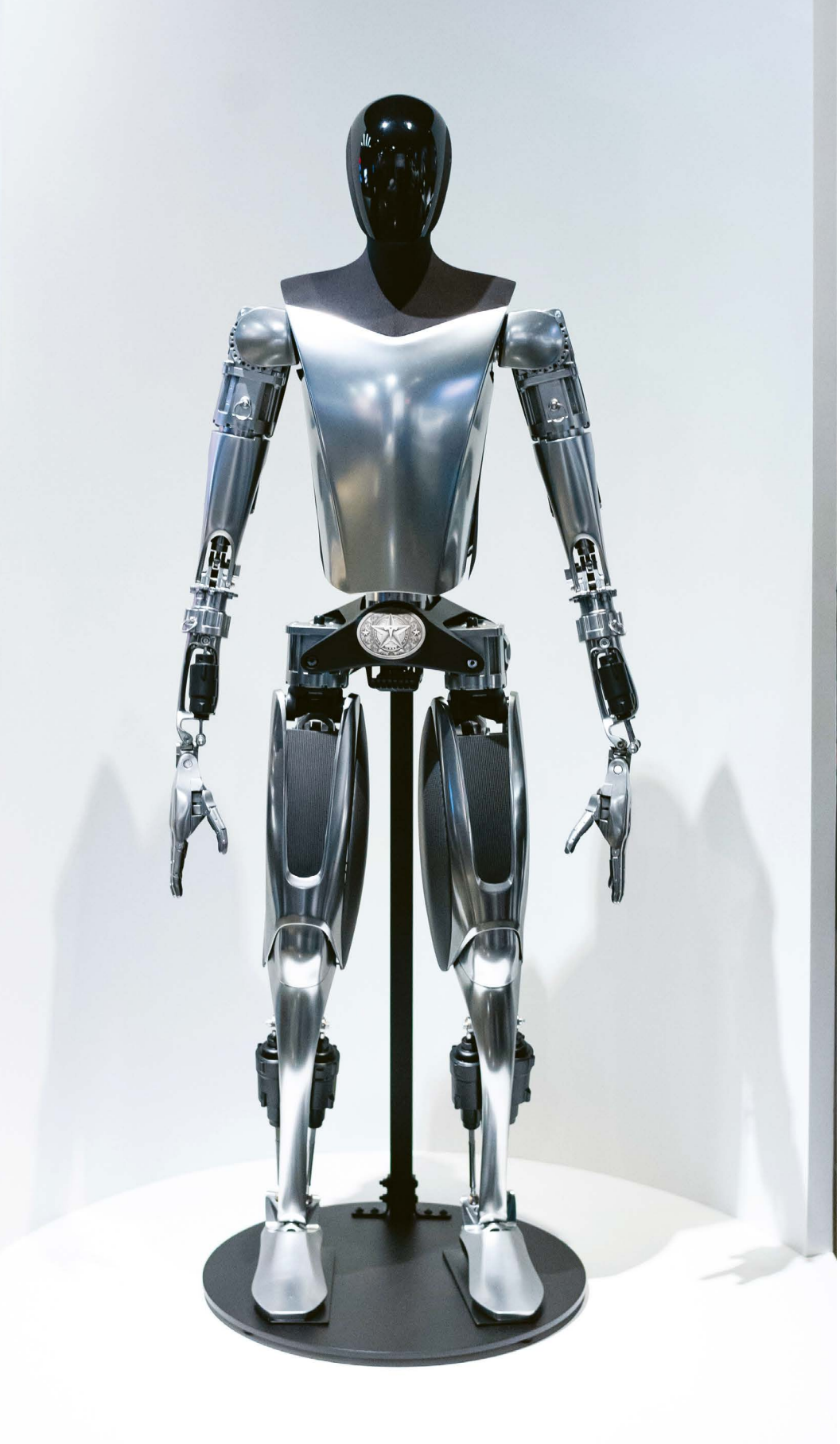
Perry provides graphic examples in which he points out the essential difference between the descriptions of the content of beliefs and beliefs themselves in which indexical expressions cannot be omitted. Based on the thought experiment about the "messy shopper" (Perry, 1979), since the shopper John Perry noticed sugar spilled on the shop floor, he believed that it had been spilled by a messy shopper. However, after realizing that the sugar bag in his basket was perforated, he concluded that he was responsible for the mess. Believing that someone spills sugar and believing that John Perry spills sugar essentially differ from his belief expressed by the sentence: "I spill sugar". After realizing that it was he who spilled sugar in the shop, and changing his belief, Perry also changed his behaviour and stopped spilling sugar. The change of belief into the belief expressed by the statement: "I spill sugar" explains the change of behaviour. Without this indexical belief, which points his/her place to the agent, his/her role and relationship towards the described situation, there would be no change of behaviour. The component expressed by the indexical expression in the indexical belief cannot be omitted since with its aid the agent determines his/her place, his/her role and relationship towards the situation, thus motivating his/her acting.

Starting from Perry's understanding that the agent's ability to translate his understanding of the world into actions depends on indexicals, Jenann Ismael considers problems related to an adequate answer and attitude towards circumstances when managing the system, the circumstances which are determined by different contextually dependent contingent facts, whereas solutions to these problems are related to the corresponding context (Ismael, 2007, p. 18). Ismael tries to integrate the self into the natural order with the aim of explaining the computing model of the self as a component of the embodied system which has been construed to solve primarily practical problems (Ismael, 2007, p. 18). She points out that the

role or the function of the structure which represents the world in the head is not to give a reflection of the nature, but to establish a connection between the elements of the internal structure and the outer space in order to direct the movement of the body in the right direction (Ismael, 2007, p. 18). For the agent to be able to understand his/her environment, it is enough to provide him/her with the source of information whose states implicitly have an *"indexical spatial content"* (Ismael, 2007, p. 18). The content of the states changes dynamically with the agent's location, enabling his/her behaviour to be aligned with the current position. The agent receives only the information directly relevant for his/her actions.

Ismael introduces a distinction between semantic and architectural relations: semantic relations refer to the relations between the elements within the "representational medium", while architectural relations connect the elements within "the representational medium" with their subject or with the elements of our media which are not part of the same semantic network (Ismael, 2007, p. 33). Within this concept, central notions are representational media and coordination, whereas representational media perform the function of information channels, while medium coordination in relation to its subject includes the establishment and maintenance of causal and contextual relations which ensure that its states correspond to information in different contexts they are used in (Ismael, 2007, p. 6). Man's consciousness is such a medium, with a role of creating models of the self and situation, connecting them with self-locating actions. These models may be composed of different elements, while self-location establishes architectural relations between the model and world components (Ismael, 2007, p. 34).

Paul Teller attempts to explain Jenann Ismael's ideas on the specific examples of artificial systems which may act autonomously, whereas such system is integrated in the "natural order" (Teller, 2011, p. 768). Teller describes an example of a "representational medium" in which the function performed is analogous to indexical expressions and indexical beliefs. Namely, Teller describes a group of robots which autonomously perform actions following the instructions relying only on the ideas of a third person (Teller, 2011, p. 767). Teller's robots are equipped with the following devices: *identification register,* which provides robots with relevant information; *deliberation modules*, which assess whether it is necessary to do the prescribed task; and *perception modules*, which enable recognizing and reporting about a certain event. These devices make it possible for Teller's robots to establish semantic relations, which include the information collected by the robot and interpreted with the aid of the above-list3ed devices, and architectural relations, which include the relations of the robot and its devices with the environment. Similarly to Perry's scenario of the "messy shopper", in the situation in which the robot with the perforated bag spills sugar, the event is recorded in the information register in the third person, with the accurate identification of the robot spilling sugar. The recording of this event in the register causes the initiation of the sub-module of the action module, the "sugar bag patching module", with the robot whose sugar is spilled (Teller, 2011, p. 767). According to it, Teller concludes that every robot acts appropriately on the basis of the third-person reports about the robot with a certain identification spills sugar, so that the real robot should perform the task of patching the sugar bag



Humanoid robot Optimus was produced by American multinational company Tesla; its prototype was first presented in 2022. In May 2024, Tesla Company presented a video in which the robot performs a number of different tasks in their factory.

Photo: Shutterstock

while using no indexical information (Teller, 2011, p. 767). However, Teller draws an exaggerated conclusion that robots do not use indexical information, since the entire setting has been devised to enable robots to interpret reports in the third person from the information register so that they self-locate.

Teller's robots are autonomous since they perform actions on their own. However, without the setting that enables their self-location, acting would not be possible. The Figure 01 robot model is autonomous even without the external setting in the form of the register network and modules, primarily thanks to large language models which enable not only the understanding of the language, either speech or language recognition of objects, but also the activation of action based on language components which are a "trigger" for action in an adequate context. The "trigger" may refer to orders, normative statements, questions, but also indexical statements. Figure 01 takes an apple from the table in front of it and gives it to the interlocutor after being asked for some food.[6] In all actions and justifications of those action, Figure 01 relates to objects, actions and the interlocutor, determining its relationship with the aid of indexical expressions, explicitly or implicitly. Moreover, Figure 01 assesses its actions by a statement which starts with a personal pronoun "I", justifying why it has completed the tasks successfully. This definitely does not imply that the robot has consciousness, but it points to the fact that it self-locates while acting. Without self-location, action would be impossible: if Figure 01 does not know that it is next to the apple and the interlocutor who asked for some food, it would not give this apple to the interlocutor.

Conclusion

That self-location is necessary for robots' autonomous action is indicated by the importance of the problem of simultaneous localization and mapping (SLAM) in robotics. This problem raises the question whether it is possible for a mobile robot on an unfamiliar location in an unfamiliar environment to make a map of the environment by researching it and simultaneously determining its own location. This method of the movement of robots and vehicles differs from the movement which is externally navigated, for example with the aid of the Global Positioning System (GPS). SLAM enables robots and vehicles to move autonomously in an unfamiliar environment in which external navigation is not possible (Durrant-Whyte & Bailey, 2006).

Although the autonomy topic still sounds like science fiction even today, autonomous robots have become reality. Furthermore, as intended to show in this paper, autonomy of robots is not an unreasonable idea, but the one that is possible to elaborate in detail and realize by constructing information systems which may act autonomously, as simple examples of Teller's robots or the sophisticated Figure 01 model analyzed here. In the future, it may be expected that autonomous robots will become part of our everyday life and even to assume most human jobs. Economist Guy Standing claims that the forthcoming technological revolution, which brings along the application of robots and AI, will disturb everyday life and make it insecure, and that is why it is necessary to introduce a system of wealth distribution in the form of

[6] See: https://youtu.be/Sq1QZB5baNw?si=g_nhbZSNRWMlNVpV (Accessed on 11. 4. 2024)

a universal basic income which would ensure everyone's right to the part of the economic benefit brought by automation and AI (Standing, 2020, pp. 31-32). Philosopher Nick Bostrom (Bostrom, 2024) speaks of post-work utopias as visions of society have accomplished full automation and thanks to it, the need for work has been eliminated. According to Bostrom, from the perspective of technological maturity, post-work utopia is a realistic vision, while from the same perspective it would be unrealistic to assume that human work is necessary. There is definitely a larger number of ominous visions of the future regarding the application of autonomous robots, which are commonly known and do not need mentioning. In any case, it may be expected that robots and AI will change every society in the world, and that is why it is necessary to consider seriously their application and society's organization about their application.

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