

Collaboration Robots as Digital Doubles of Person for Communication in Public Life and Space

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Abstract: Trans-sectoral digital research of man, nature, society and industrial communication allows to create digital twins of social services. Digital duplicates associated with the service sector are created for intelligent process management. Digital twins of man provide services in the social sphere and in space. Training of digital twins in professional competences is carried out on the basis of communicative associative logic of technological thinking by cognitive methods. The study of the effectiveness of machine learning techniques, allowed the use of an approach that allows the combination of artificial intelligence and cognitive psychology. This approach provided pre-preparation of neural networks from accumulated data using existing behaviors. The approach combines existing scientific theories of human behavior with the flexibility of neural networks to make better decisions made by humans in space and in extreme situations. From a practical point of view, this makes it possible to more accurately determine the behavior of the human digital twin in space and in extreme situations. There are a number of socio-economic issues related to human-machine interaction. Complex technologies are not credible on the part of citizens. The coming years will take to improve safety and standardize the creation, application of digital twins and behavior of robots.

Keywords: Technological Thinking, Communicative and Associative Logic, Digital Doubles, Communicative Associative Logic, Adaptive Behaviour

1. Introduction

The term Digital Twins appeared in the early 2000s, but every year, as technology developed, it received new content. The basic concept is not difficult to understand: monitoring of a physical object is carried out on the basis of a closed cycle of information exchange between it and its virtual model (thus a digital twin).

A digital twin is a virtual prototype of a real object, group of objects, or processes. It is a complex software product that is built from a wide variety of data. The digital twin is not limited to collecting data obtained during the development and manufacture phase of the product - it continues to collect and analyze data during the entire life cycle of the real object, including through numerous IoT sensors. A digital twin is a virtual reproduction of the operational state of a real physical object, process, system, or whole service. It can be a virtual twin of a part, product, equipment, process, production sites, workshops, or even factories. It is essentially a set of

mathematical models describing the state of an object and all its elements. In general, the digital twin includes: geometric model of the object; set of calculated data of parts, nodes and the object as a whole (Mathematical models describing all physical processes taking place in the object); information on technological processes of manufacturing and assembly of individual elements; some data on tests of the object, for example, readings of sensors, from which calculated data can be confirmed; system of product life cycle management, which links all the above objects into a single structure.

The digital twin is used in association with the physical throughout the life cycle: during the testing, rework, operation and disposal phase. The physical object uses sensors that collect real-time data about the state of the object, after which this information is sent to the digital twin. On the basis of the obtained data, the digital model is clarified, which, in turn, gives recommendations for optimization of the operation and maintenance mode of the real object.

The digital twin allows you to simulate in virtual space the change in the state and characteristics of the entire product when the characteristics of any of its elements change. Its main task is to allow real-time management of all factors affecting the cost and quality of the product even before its production begins.

Digital twins are created to significantly accelerate the time to market of new products, so you can present all stages of its life cycle in a virtual environment. Another function of the digital twin is to inherit product data when modifications are made to it. In other words, to maximize the use of previous experience in designing, manufacturing, and testing new product modifications. In this case, we take into account the peculiarities of the product operation and on the basis of the data obtained from the digital twin, we can improve the characteristics of the product modification.

The main advantage is the speed of making technical decisions and the cost of obtaining the required characteristics of the product. Having a digital twin, it is possible to reduce by an order of magnitude the number of natural tests, the number of attempts to work out technological processes, all that is connected with the production of a real material part and its tests, the cost of which is much higher than the cost of mathematical modeling.

Another advantage is the possibility of collective work on the product of geographically remote collectives and engineering centers. At the same time, the necessary scientific potential and labor resources can be used than with manual design technology.

If we consider the digital twin not of a specific product, but of the whole production, the advantage is the possibility to simulate in a virtual environment all processes, to determine the necessary quantity and optimal location of equipment depending on the volume and range of products produced. At the same time, if a digital twin is developed for the newly created production, it is possible to identify possible risks and shortcomings through simulation of its work, to correct the project. The digital twin of existing production allows you to work out the implementation or change of technological processes without real interference with the work.

Digital twins allow you to model a variety of situations that can occur in production. Thus, the digital twin allows to select the most adequate scenarios of technological processes to avoid failures and force majeure. Digital twins help improve the efficiency of the cloud platform, solve design problems early, train employees, support innovation, and more.

Digital twins are starting to use companies of different industries, such as energy, transport, construction, but first of all it works in high-tech industry [1-3]. The most dynamic market where digital twins are used is the global automotive industry, which produces 100 million units annually.

2. Automation Methods

First of all, these are numerous methods of modeling

processes (physical and information), which both assess its current work and allow to make forecasts for the future: how the model will behave when changing its parameter. Other methods allow you to study the external parameters and structure of an object, analyze properties, or examine existing parameters and running processes. The third is to obtain data and reliability of the object or system obtained on the basis of a model analyzing the consequences of risks. At the same time, all data can be obtained together and analyzed in a complex.

It is also necessary to build accurate analytical models that can be applied to the digital twins. By digital twin is meant a set of digital technologies that use approaches of statistical analysis, machine learning, chemistry, physics, control theory, reliability theory, mass service theory, numerical modeling, optimization, simulation modeling.

Solutions using digital twins are built on a whole set of technologies.

Digital Twin Aggregate, DTA (Aggregated Twin), is a standard computing system that combines all digital twins and their actual prototypes, allowing data to be collected and exchanged. DTA twins are defined as a computing system that has access to all digital twin instances and can send them requests in random or active polling mode.

The digital twin allows to reproduce all other indicators of the object by minimum key parameters. With this technology it is possible to solve various classes of tasks of diagnostics of object state, forecasting, optimization of operation, control.

The digital model also contains a history of maintenance and operation. Taken together, all of this data makes it possible to predict the behavior of a real object. In addition, it is possible to monitor and test the entire fleet of facilities and carry out analysis on the basis of aggregated data.

It is important to note that machine learning technologies are also involved in digital twins, because they are essentially self-learning systems that use information from a range of sources, including data from sensors monitoring various performance indicators of the physical object, information from expert experts and larger systems, of which the observed physical object may be a part.

Digital twins can also be created for business processes. Automation methods allow to model the optimal path of development.

Digital twins have become a really strong catalyst for the development. Robots as human digital twins [4-7] significantly save resources, minimize risks of errors and failures, which prolongs the period of stable operation. All this allows to get the maximum possible return on investments, increase competitiveness and increase demand.

3. The Adaptive Behavior Digital Robots

Today there is a set of algorithms of machine learning on the basis of which it is possible to construct scoring model: Decision Tree (decision tree), KNN (method of the k-closest neighbors), SVM (method of basic vectors), NN (neuronet). And the choice

of model should be based on what we want from it. First, as far as the decisions which affected results of model have to be clear. In other words, as far as it is important to us to have an opportunity to interpret structure of model of adaptive behavior. They give the chance very deeply and seriously to configure architecture and settings of training [8-16].

Very soon the need for call center services will disappear, and no longer have to wait. According to a study conducted by Gartner, artificial intelligence will perform 85 percent of customer service work by 2020. In principle, this was to be expected, as Facebook and other social networks successfully use chat bots to process calls to support. When artificial intelligence takes matters seriously, waiting times for various transactions will be significantly reduced, which is an obvious benefit for companies and their clients.

Gartner also reports that artificial intelligence will "mimic human communication by learning to listen and speak, remember what has been heard, take into account the situation, time and tone of the conversation. Robots will maintain communication, develop your thoughts and suggestions about various accidents and objects. "In other

words, an electronic assistant will be able to recognize a person closer, and a conversation with a cyborg will resemble a friendly conversation or something like that.

By 2018, artificial intelligence will create 20 percent of business content. Artificial intelligence will significantly affect the economy. The Bank of America, in a report to investors, indicated that the introduction of artificial intelligence would affect the economy in the form of a recession in some of its areas, with substantial growth in others. Overall, this "creative destruction" is estimated at \$14-33 trillion. According to experts, the process is just beginning. Investing in these technologies is guaranteed to generate income.

4. Specialization of Cognitive Adaptive Professional Robot

The functional structure of specialization of the cognitive adaptive professional robot with retraining consists of various systems with artificial intelligence (Figure 1).

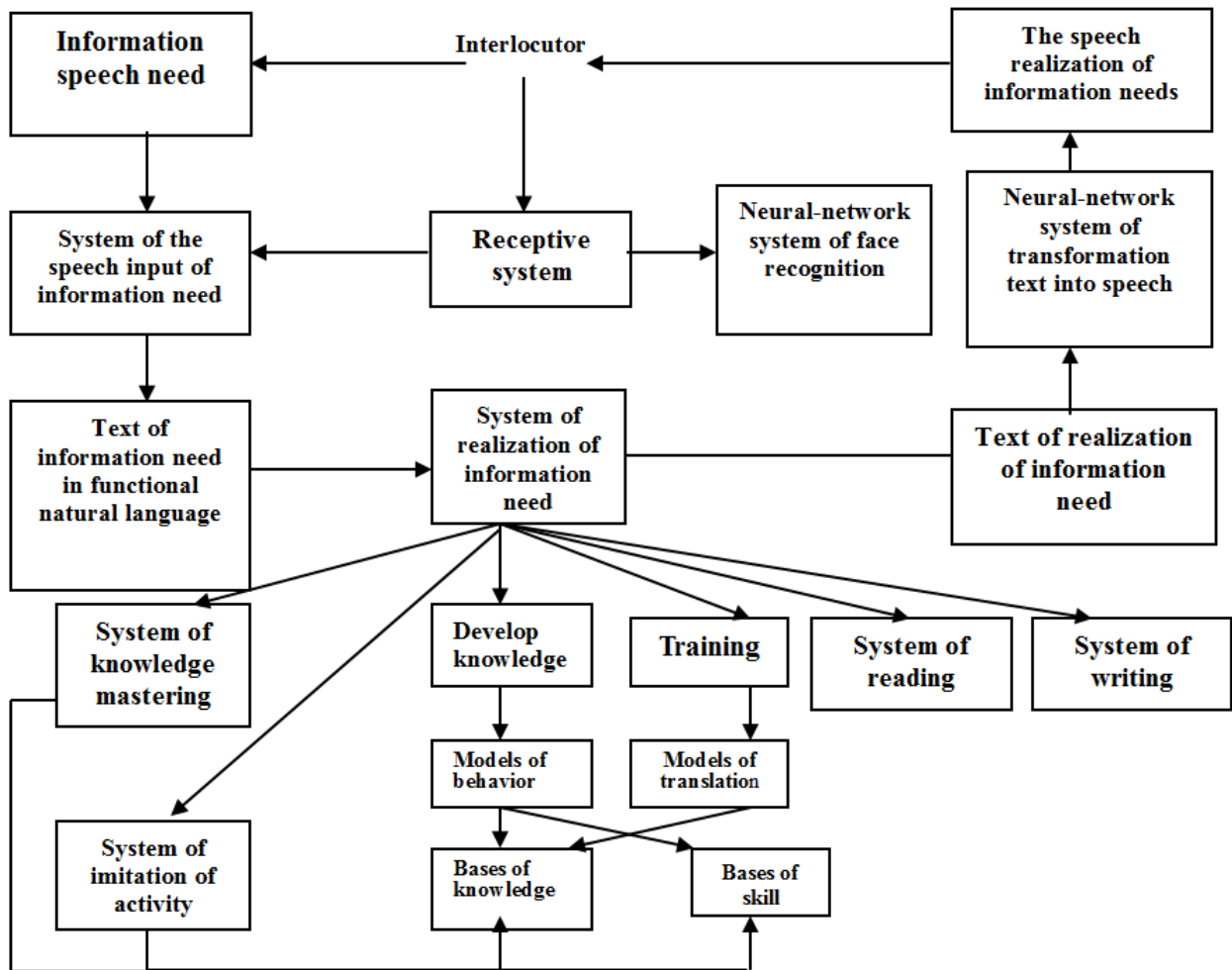


Figure 1. Functional structure of the cognitive professional digital doubles.

Specialization of cognitive adaptive robots is carried out on the basis of knowledge bases, bases of abilities and implementers of behavior. Cognitive adaptive robots with

imitative thinking and adaptive behavior have prospect of broad practical application.

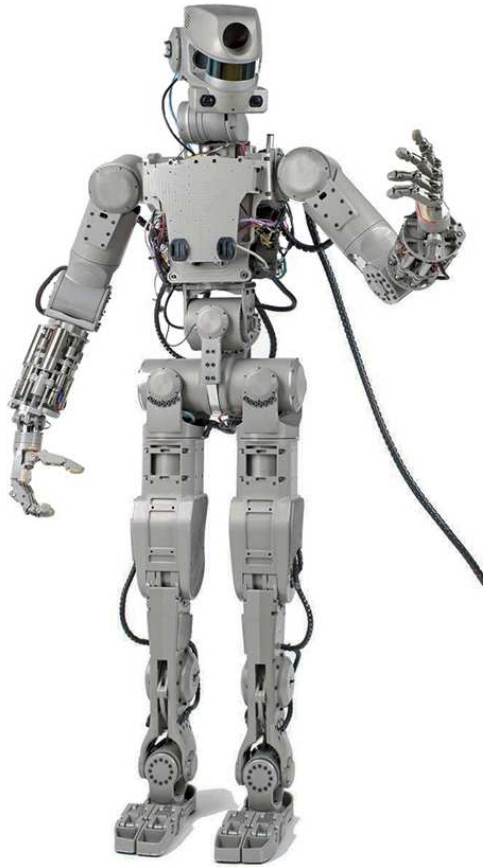


Figure 2. Russian robot astronaut FEDOR for work in space.



Figure 3. Japanese robot lecturer on literature.



Figure 4. American mobile robot security guard Atlas with adaptive behavior.



Figure 5. Japanese robot-administrator of hotel Henn-na Hotel.

5. Conclusion

The cognitive adaptive professional robots with communicative and associative logic of thinking having the systems of machine retraining of realization of information requirements will be able quickly to change professional qualification and competences. The smart cognitive architecture of the robot using criterion of improvement of functional activity is capable to recurrent self-improvement. The cognitive architecture includes artificial neural networks, algorithms of machine learning, the cognitive smart big data system, the system of high-quality selection. The smart cognitive architecture of the robot step by step defines how it is the best of all to achieve the set objectives and to realize preferences by means of actions of function of usefulness on the basis of high-quality selection. Self-improvement is carried out by machine retraining by criterion of preferences on the basis of extensive statistics of high-quality selection of skills and competences. The smart cognitive architecture of the robot seeks for development of all aspects of artificial intelligence by machine retraining, on the basis of extensive statistics of the acquired professional and behavioural skills.

The international scientific and engineering society gradually moves to technical realization of the cognitive professional robot with retraining. The group of the University of California in Berkeley and Princeton investigating efficiency of methods of machine learning for forecasting of human behavior offered the new approach which is given rise on a joint of AI and cognitive psychology. Scientists presented the new concept providing preliminary training of neural networks at the synthetic data prepared by psychologists by means of the existing theoretical models. Approach can be used by other groups for a training of their own models of machine learning. Approach combines the existing scientific theories of behavior of the person with flexibility of neural networks for the best forecasting of the risky decisions made by the person. From the practical point of view it allows to save to researchers a lot of time which is spent usually on data collection for the knowledge base of human behavior.

The automated system of retraining can retrain the cognitive robot on other specialization, described in article. The expert has to prepare the knowledge base, base of

abilities, behavior model and model of the environment. Degree of accuracy of the description of the external environment, behavior model and realization of information requirement defines correctness of performance of human tasks by robot.

In the future in labor market cognitive robots with retraining will perform professional works, and the person will occupy a niche of scientific research of creative innovative activity.

Robots become independent subjects of social environment. Social cognitive smart robots are used as guide, seller, lecturer, vacuum cleaner, nurse, volunteer, security guard, administrator of hotel, astronaut.

References

- [1] Evgeniy Bryndin. Human Digital Doubles with Technological Cognitive Thinking and Adaptive Behaviour. *Software Engineering, Volume 7, Issue 1*, 2019. P. 1-9.
- [2] Evgeniy G. Bryndin, Cognitive robot consultant for a healthy lifestyle. III International scientific conference "Information Technologies in Science, Management, the Social Sphere and Medicine". TPU. 2016. Pages 484-488.
- [3] Evgeniy Bryndin. Cognitive Robots with Imitative Thinking for Digital Libraries, Banks, Universities and Smart Factories. *International Journal of Management and Fuzzy Systems*. V.3, №.5, 2017, pp 57-66.
- [4] Markets and Markets Research-"Collaborative Robots Market", 2017. URL: <https://www.marketsandmarkets.com/Market-Reports/collaborative-robot-market-194541294.html>
- [5] Robotics Business Review-"The 2017 RBR50 List Names Robotics Industry Leaders, Innovators", 2017 URL: <https://www.roboticsbusinessreview.com/download/2017-rbr50-list-names-robotics-industry-leaders-innovators/>
- [6] Cision. "Top Robotics Market by Industrial Robotics, Service Robotics-Global Forecast to 2022", 2017. URL: <https://www.prnewswire.com/news-releases/top-robotics-market-by-industrial-robotics-service-robotics-global-forecast-to-2022-300405291.html>.
- [7] Gizmodo. "Robots Are Already Replacing Human Workers at an Alarming Rate", 2017. URL: <https://gizmodo.com/robots-are-already-replacing-human-workers-at-an-alarming-1793718198>
- [8] *Stefan Wermter, Günther Palm, Mark Elshaw*. Biomimetic Neural Learning for Intelligent Robots: Intelligent Systems, Cognitive Robotics, and Neuroscience. Springer-Verlag Berlin Heidelberg. 2005. 389 pages.
- [9] Evgeniy Bryndin. Technological Thinking, Communication and Behavior of Androids. *Communications*. Vol. 6, No. 1, 2018. Pages: 13-19.
- [10] *Evgeniy Bryndin*. Program Hierarchical Realization of Adaptation Behavior of the Cognitive Mobile Robot with Imitative Thinking. *International Journal of Engineering Management*. Volume 1, Issue 4. 2017, pp. 74-79.
- [11] *Pedro Domingos*. Supreme algorithm. How machine learning will change our world.-M.: Mann, Ivanov and Ferber, 2016.-336 pages.
- [12] Evgeniy Bryndin. Social Cognitive Smart Robots: Guide, Seller, Lecturer, Vacuum Cleaner, Nurse, Volunteer, Security Guard, Administrator. *Communications*. Volume 7, Issue 1. 2019. Pages: 6-12.
- [13] Artificial Intelligence & Robotics: Industry Report & Investment Case. 2019. <https://indexes.nasdaqomx.com/docs/NQROBO%20Research.pdf>.
- [14] Deep Learning based Recommender System: A Survey and New Perspectives, Shuai Zhang et al., 2018. <https://arxiv.org/pdf/1707.07435.pdf>.
- [15] *Evgeniy Bryndin*. System retraining to professional competences of cognitive robots on basis of communicative associative logic of technological thinking. *International Robotics Automation Journal*. 2019; 5 (3.): 112–119.
- [16] Google's Artificial Intelligence Built an AI That Outperforms Any Made by Humans. 2019 <https://futur-ism.com/google-artificial-intelligence-built-ai>.