International Journal of Systems Science and Applied Mathematics
2019; 4(3): 31-37
http://www.sciencepublishinggroup.com/j/ijssam
doi: 10.11648/j.ijssam.20190403.11
ISSN: 2575-5838 (Print); ISSN: 2575-5803 (Online)

Robots with Artificial Intelligence and Spectroscopic Sight in Hi-Tech Labor Market

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To cite this article:
Evgeniy Bryndin. Robots with Artificial Intelligence and Spectroscopic Sight in Hi-Tech Labor Market. *International Journal of Systems Science and Applied Mathematics.* Vol. 4, No. 3, 2019, pp. 31-37. doi: 10.11648/j.ijssam.20190403.11

Received: August 21, 2019; **Accepted**: September 17, 2019; **Published**: September 26, 2019

Abstract: The artificial intelligence of the robot is the digital double of intelligence of the person capable to training, retraining, self-realization and development of professional and behavioural creative innovative competences and skills. The robot represents a technological and program cognitive complex. The realization of artificial intelligence the robot is enabled on the basis of criterion of preferences of improvement of functional activity by realization of actions of function of usefulness and high-quality selection of extensive statistics of the accumulated professional and behavioural creative innovative competences and skills of the person. Transdectoral digital studies of human, nature, society and production communication enable the creation of digital twins of social services and production of products and the technological process of equipment operation. Digital dupes related to the service sector or production are created for intelligent process and equipment management. Intelligent production management with a digital twin optimizes its operation, increases productivity and competitiveness of products according to quality and price. Human digital twins 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. Cognitive psychology experts investigating the effectiveness of machine learning techniques offer a new approach that allows artificial intelligence and cognitive psychology to be combined. This approach provides 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 a human digital twin in space and in extreme situations. The spectroscopic sight of the robot perceives objects and objects of their range of frequencies. For training of the robot in recognition of objects and objects the frequency spectral technology of machine learning is used. The spectroscopic sight perceives a range of radiations of objects, and the artificial trained neural network distinguishes them on a range.

Keywords: Artificial Intelligence, Digital Double, Criterion of Preferences, Function of Usefulness, Qualitative Selection, Spectroscopic Sight

1. Introduction

Robots can solve a set of various practical problems. The medicine, bank service, the industry, education, hotel business and even entertainments are the main scopes of robots.

Health care – one of the most progressive spheres in which work of robots is applied. Now actively the robotic surgery develops. In medicine will reach big break since bionic artificial limbs which the person can operate by means of own nervous system began to be used. Moreover, by means of an artificial limb of people can feel touch, heat and pressure.

Robotic systems apply in the sphere of safety: devices with special sensors quickly find fire-dangerous situations and successfully prevent them.

The modern plants and the enterprises far promoted due to modern technologies. The automated industrial robots are used to welding, laying, painting and other operations demanding repeated repetition and high precision.

Recently the smart home – the automated network controlling electricity, water supply, safety and other systems enjoys the increasing popularity.

In Japan, Russia, Taiwan, China and other developed countries were created androids who are able to support a conversation and even to joke.

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. Consultant, lecturer and teacher (Figure 1).

Figure 1. *Japanese robot lecturer.*

Robot-Android volunteer ASIMO (Figure 2).

Figure 2. *Japanese robot-Android volunteer ASIMO.*

Mobile robot security guard Atlas (Figure 3).

Figure 3. *American mobile robot security guard Atlas.*

Japanese robot-administrator of hotel Henn-na Hotel (Figure 4).

Figure 4. *Japanese robot-administrator of hotel Henn-na Hotel.*

Astronauts robots are actively used by the person in development of open spaces of the Universe. They collect samples of the soil and investigate new spaces in the conditions of the raised radiation and extreme temperatures. The Russian FEDOR Robot (Final Experimental Demonstration Object Research) — anthropomorphous robot is astronaut Skybot F-850 (Figure 5).

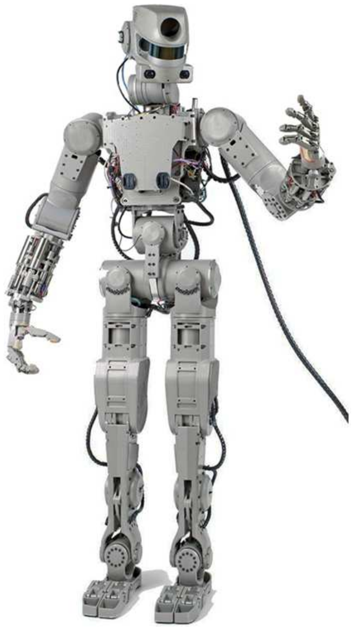

Figure 5. *FEDOR robot.*

There are robots for hi-tech work which on teeth to artificial intelligence.

With the advent of artificial neural networks in the modern world robots learned to create. In modern life of people already uses robots in all spheres of the activity [1-10]. In the majority robots are not replaceable assistants. The person tries to create, for the robots, artificial intelligence. With artificial intelligence robots will be able independently to estimate the events around them and to make decisions on actions which they need to make.

The development of AI and machine learning technologies and their application in robotics is a prerequisite for the creation of really useful and smart robots. Statistical methods and machine learning, including artificial neural networks of deep learning, have had a huge impact on modern robotics. The architecture of networks is becoming more complex and capacity is increased while maintaining an acceptable learning speed, as well as the development of systems that will allow neural networks to operate with minimal energy consumption. An important task in improving the efficiency of machine learning is to reduce the learning sample while maintaining the speed and quality of learning. Training in action algorithms begins. A neural network trained on the example of a single labeled dataset can self-train and draw conclusions on unmarked datasets. As a result, learning becomes faster, large amounts of data are processed, and the quality of results is improved.

Current robotics practice shows that the best results in increasing productivity can be achieved from the maximum efficiency of the bundle of robot teams and people working together to achieve a common goal. Social interaction between humans and robots in everyday and working life is the subject of numerous studies, some of which have become the basis of as many billions of industries. An example of successful implementation of social interaction technologies is voice assistants and chat bots.

Robots can already both record human movement skills and copy them. Machine learning improves drive efficiency and mobility. As a result, more complex movements will be achieved by simpler means. Now the developments in this direction are carried out by Boston Dynamics and MITs with the robot Atlas. Researchers hope that if successful, the application of neural networks will find new variants of movements that will be more effective. In the coming years, the quality of training will improve, as will the degree of autonomy of robots

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 and behavior of robots [11].

In article approach to creation of robots with spectroscopic sight and artificial intelligence, capable to work at the market of hi-tech work briefly is considered.

2. Cognitive Smart Architecture of the Robot

The cognitive smart architecture includes artificial neural networks, algorithms of machine learning, the cognitive smart big data system, the system of high-quality selection (Figure 6).

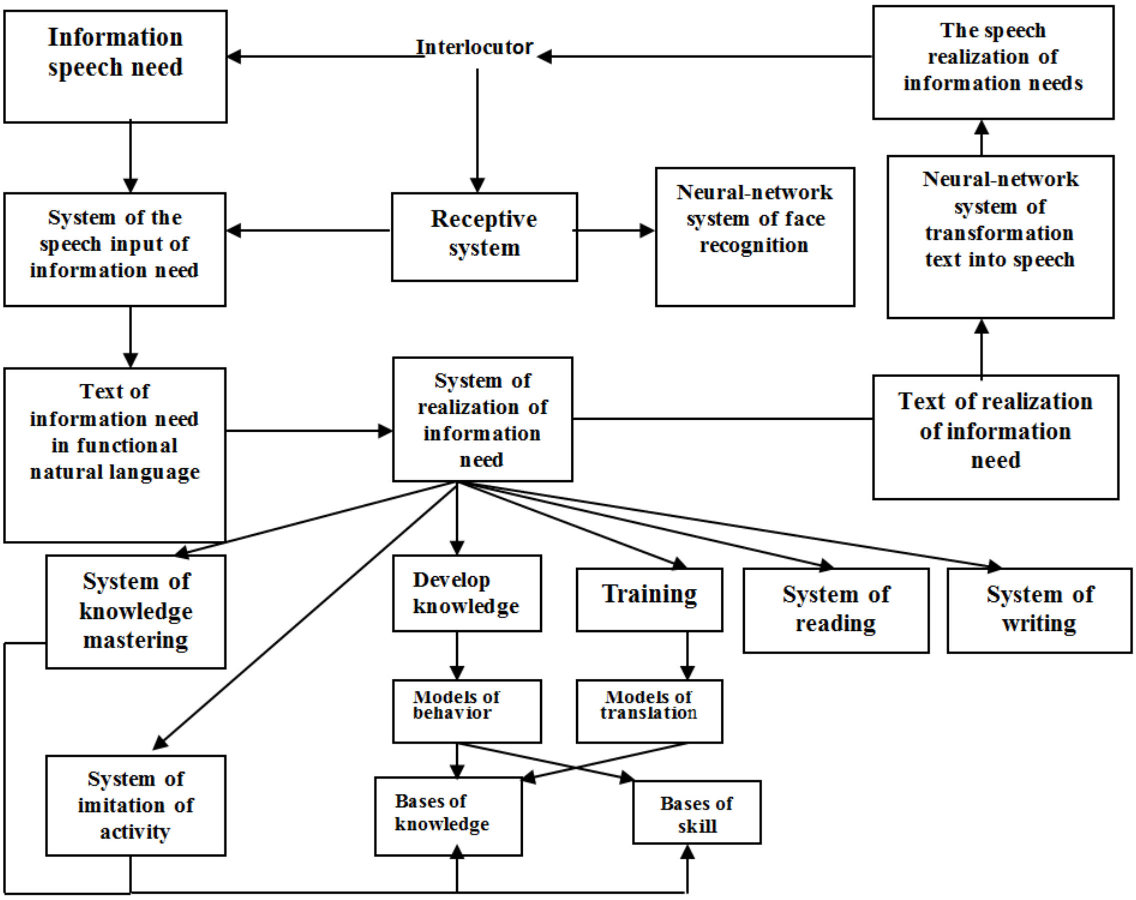

Figure 6. *Smart architecture of the robot with artificial intelligence.*

The cognitive architecture of the robot on the basis of criterion of preferences develops functional activity. 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. Professional self-improvement is carried out by machine retraining by criterion of preferences on the basis of extensive statistics of high-quality selection of the saved-up creative innovative skills and competences in the sixth technological way of the industry 4.0.

The smart cognitive architecture of the robot develops its artificial intelligence by machine retraining, on the basis of extensive statistics of the creative innovative competences and of base of abilities of the corresponding professional and behavioural skills accumulated in the knowledge base.

3. Automation Methods

The primary storage location for digital twins is the cloud. A variety of information tools are used to store digital twins. First of all, these are numerous methods of modeling processes (physical and information), which both assess its current work and allow 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 before you create it, 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.

Industry 4.0 offers the option of obtaining digital twins of technological processes: with the help of machine learning of neural networks, which use a huge array of data about the production process. A lot of data needs to be collected, so you need a truly robust collection and processing strategy to use the full data and get competitive product quality. The digital twin must be re-trained after process reconstruction or modernization.

It is also necessary to build accurate analytical models that can be applied to each of 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. The virtual model is typically in the cloud. Various tools are used to build a comprehensive model of digital twins, in particular, numerical methods of modeling physical processes in object materials are used to predict the reaction of the product to different operational loads.

Use numerical methods to simulate physical processes in object materials to create a complex process twin model. With the Finite Element Analysis (FEA) method, you can model the behavior of complex systems by breaking them down into multiple elements small enough to treat their properties as uniform. CAD models (computer-aided design/drafting tools) are also used, which contain information about the appearance and structure of objects, materials, processes, dimensions, and other parameters. FMEA models (Failure Mode and Effects Analysis) based on system reliability analysis are also used. They can combine mathematical failure models with a statistical database of failure modes. In fact, it is a methodology for analysing and identifying the most critical steps of production processes.

Experts identify three types of twins: Digital Twin Prototype (DTP), Digital Twin Instance (DTI) and Aggregated Twins (DTA).

Digital Twin Prototype (DTP, prototypes) is a virtual analogue of a reality physical object. It includes data to comprehensively characterize the model, including information on how to create it in real-world settings. The list includes:

1) Production requirements,
2) 3D model of the object
3) Description of materials and their specifics,
4) Process plans and/or services to be performed,
5) Disposal requirements.

A DTP twin characterizes a physical object of which it is a prototype, and contains the information necessary to describe and create a physical version of the object. This information includes manufacturing requirements, annotated 3D model, material specification, processes, services, and disposal.

Digital Twin Instance (DTI) is a description of a physical object. In most cases, they contain:

Is an annotated 3D model that includes general dimensions and tolerances.

1) Material data based on past and present time and components,
2) Information about the running processes in all time lines, including those performed when the object was created,
3) Results of all test operations,
4) Records of performed repairs (planned, unscheduled, preventive), maintenance, replaced parts and components,
5) Operational data received from sensors,
6) Monitoring parameters (early, current and expected).

DTI twins describe a particular physical object with which the twin remains associated throughout its lifetime. Twins of this type typically contain an annotated 3D model with common dimensions and tolerances, A material BOM that lists the current and past components A specification for processes that list the operations that were performed when this physical object was created. As well as the results of any on-site tests, service records, Including replacement of components, operational indicators, results of tests and measurements from sensors, current and predicted values of monitoring parameters.

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 product 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 other similar machines or car parks, As well as larger systems, of which the observed physical object may be a part.

Digital twins can also be created for an entire enterprise along with all its business processes. Automation methods allow to digitize the production process and present in the form of a digital twin, which serves to see a situation in development, to predict its final result and to try to model the optimal path of development.

Digital twins have become a really strong catalyst for the development of modern companies. Digital twins together with robots [14-15] significantly simplify technical support of the production process, save resources, minimize risks of errors and failures, which prolongs the period of stable operation of the company. All this allows to get the maximum possible return on investments, increase competitiveness and increase demand.

4. Approaches to Detection of Preferences

Artificial intelligence achieves preference-based goals. To reveal preference on set of objects A, it means to specify set of all couples of objects (a, b), for which an object a it is more preferable, than b. At detection of preference the following approaches are possible.

i. Unconditional approach on the basis of the table.

Let's fill out the table by the principle:

aij=1, if i object is better than object j;

aij=0 if, i object is worse than object j.

ii. Logical approach.

Approach includes three stages:

1) Private criteria by which there is a choice of preferences are distinguished;
2) The table "alternative-part criteria" in which for each alternative values of quantitative private criteria or ranks of qualitative criteria are specified is formed.
3) The decisive rule for definition of the best alternative is chosen.

As the considered private criteria – qualitative, are given them not quantitative, but rank estimates (on preferences). Rank estimates can be considered as points. On their basis it is necessary to define preference. The decisive rule is for this purpose created. For example, (1), (2), (3).

1) Absolute preference. The alternative of ai is more preferable than aj alternative if by all private criteria of ai is more preferable aj or is equivalent to it. The absolute preference has property of transitivity (if A more preferably B and B more preferable than C, then A is more preferable than C).
2) Preference by the rule of the majority. The alternative of ai is better, than aj if the amount of private criteria by which ai is better than aj are more than amount of criteria by which ai is worse than aj.
3) Criterion of the largest sum of mark estimates. Instead of quantitative estimates of private criteria it is possible to put down their rank values. The value of a rank is considered as mark assessment, and for the worst value the smallest point — 1, and for the best value — the greatest point is given. Then the criterion of preference is formulated so: the alternative of ai is better than aj alternative if the sum of mark estimates for ai is more, than for aj.

When using criteria of preference by the rule of the majority or the sum of mark estimates often the additional requirement – lack of private criterion with the worst value is imposed on an alternative. Such alternatives are excluded from consideration at once.

At a large number of alternatives and private criteria direct definition of the best alternative by criterion of the majority becomes difficult because of complexity of calculation of number of the best and worst criteria for each alternative. In this case for allocation of the best alternative it is necessary to make the table of preferences.

By the rule of the majority and lack of the worst value the table of preferences for alternatives is formed: if the alternative of b is more preferable than a, then on crossing of line b and column a is put 1, differently 0.

5. Useful Choice

Useful choice is function by means of which it is possible to present preferences on some set of unrealized hi-tech demand. The concept "usefulness" was entered into economic science by the English philosopher Jeremiah Bentam (1748–1832). Today all science about market economy, in fact, keeps on two theories: usefulness and cost. By means of category of usefulness operation of the law of demand speaks. The digital double of artificial intelligence of the robot analyzes unrealized demand for hi-tech products in the market. The choice of unrealized demand for hi-tech products in the market in practice is connected with use of key indicators of cost efficiency of NPV, IRR, PB, PL, ROI and other. The robot determines the participation in unrealized demand for hi-tech products by key indicators of cost efficiency. He chooses and masters new competences and skills of technological program functional selling of goods or services for operational satisfaction of demand with the smallest costs of production [12-19].

6. Spectroscopic Sight of the Robot

Studying of feature of interaction of the radiation (light) with particles which size less than the wavelength is engaged nanooptics. Technologies in the field of nanooptics include the scanning optical microscopy of the near field, the photostrengthened scanning tunnel mikroskopiiya and spectroscopy of a superficial plazmonny resonance. The traditional microscopy for exact focusing of light uses diffraction elements for the purpose of increase in permission. However, because of a diffraction limit (known as criterion of permission of Rayleigh) the spreading light can be focused in a spot with the minimum diameter which is a half of wavelength of light. Therefore, for diffraction and limited microscopy the most achievable permission is about two hundred nanometers.

In 2014. The Nobel Prize in chemistry was awarded to Eric Bettsigu (USA), William Merner (USA) and Stefan Hell (Germany) for development of methods of fluorescent microscopy with the ultrahigh permission. These methods were widely adopted since 2008 when the microscopy of ultrahigh permission was recognized as "method of year" in special issue of the Nature Methods magazine. The key moment of a method - is obtaining information on various parts of a nanoobject independently of each other. Scanning two lasers with the bright center, you pass on all sample and see very thin structure with the permission in nanometers. This system is called a nanoskopiya. Nanoskopiya allows to see very thin structures. Specification of the obtained information increases. Now the optical nanoskopiya with over permission can use for realization of frequency spectral sight of robots.

Technical spectral vision developers seek to expand their spectral range, spectral and spatial resolution. This raises the challenge of integrated use of several instruments operating in different spectral bands. It would be useful to use the combined use of a monophotonic UV-C sensor and hyperspecter modules in the visible near infrared range. UV-C sensor is able to quickly detect the object of interest and transmit its coordinates to the control unit to guide the hyperspectometer to the target and its detailed shooting with high spectral and spatial resolution. In multi-spectrum enhanced vision systems, choosing a strategy for combining information from multiple video channels plays an important role. The robot's spectroscopic vision helps it perceive the frequency spectra of objects and objects of the environment. Practical application of hyperspectration sensors of visible and near infrared range covers a wide range of tasks of science and national economy as: geology, agriculture, forestry and water economy, ecology, urban infrastructure and many others.

CNN's twist neural networks are an effective tool for detecting and classifying objects. The artificial trained neural network distinguishes their range, is associative compares to the saved-up ranges of objects and objects in the frequency base. By associative comparison defines a subject or an object [20].

7. Conclusion

Technologies of artificial intelligence hold special position in structure of digital transformation, affecting all spheres of our life: from a consumer sector before the industry. Technologies of artificial intelligence are widely demanded in the most different branches of digital economy, but their full-scale practical use constrains backwardness of the regulatory base so far. To simplify understanding, to facilitate introduction, to remove regulatory barriers concerning technologies of artificial intelligence to the widest audience of potential users standardization in the field of technologies of artificial intelligence within the International Organization for Standardization (ISO) is carried out, first of all. Participants and leaders of discussion are representatives of the companies - developers of the technologies and solutions of artificial intelligence interested in creation of the favorable environment in economy and in society for effective implementation of artificial intelligence in practice. Algorithms, methods and technologies of artificial intelligence constantly extend in the direction of natural intelligence.

Artificial Intelligence becomes scientific applied direction on development and creation of technological and program cognitive complexes of the digital double of intelligence of the person of technological and program cognitive complexes of the digital double of intelligence of the person capable to training, retraining, self-realization and self-improvement on the basis of criterion of preferences and to improvement of functional activity by the high-quality choice and development of creative innovative hi-tech professional and behavioural skills and competences.

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