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United Scientific Open Discovery

Journal of Advanced Artificial Intelligence Systems and Frontiers
Volume 1 | Issue 2

Research Article

# Intelligence Robotization for Library and Social Activity

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**Citation:** Evgeny Bryndin (2026) Intelligence Robotization for Library and Social Activity. J of Adv Art Int Sys & Frontiers 1(2):1-10.

**Received Date:** October 07, 2026
**Accepted Date:** October 12, 2026
**Published Date:** November 09, 2026

**Abstract**

The intellectual robotization of library and the social sphere takes on an international scale. The creation of smart robots for various spheres of human life is associated with high technology and artificial intelligence. Currently, the development of artificial intelligence for industrial and social robotics is carried out by information technology, cognitive robots, digital twins and artificial intelligence systems. The ensembles of intelligent mobile diversifiable agents with strong artificial intelligence are central to the development of artificial intelligence for industrial and social robotics through the recurring development of professional skills, increasing their visual, sound, subject, spatial and temporal sensitivity. Working with big data, diversify and transform the high-tech industry and the social sphere. The cognitive ensembles of mobile diversifiable agents, technology platforms and analytical systems allow you to quickly and efficiently solve the tasks of collecting, analyzing and visualizing large amounts of data. Effective collection and analysis of big data, their rapid updating using strong artificial intelligence will accelerate industrial and social robotics by teaching new skills. Intelligent robotization based on large ensembles of intelligent agents processing big data requires faster supercomputers. Communication and control of the robot through the mental neurointerface accelerates the training of industrial and social communicative-associative robots, the development of their intelligence, and makes them natural assistants in improving the life of society. The rapid technological and intellectual development of library activities requires staff training.

**Keywords:** Artificial Intelligence, Smart Robot, Ensembles of Intellectual Agents.

## Introduction

there are various approaches to the development of artificial intelligence for various areas of life [1-9]. The article outlines the direction of the development of artificial intelligence for production high-tech robotization to industry level 5.0, as well as for human-like robotization of the social sector of services in order to improve the quality of life. A mental approach to the interaction of a person with a robot, as well as specialists among themselves, is proposed.The article consists of sections. The first section discusses aspects of advanced artificial intelligence of self-organizing ensembles of intelligent agents to create human-like robotization.The second section is devoted to the use of humanoid robotics in industry, the social sphere, in the high-tech field and space. Experts strive to create a smart human-like robot. The creation of a humanoid robot is associated with the implementation of a large number of functions and competencies. The author proposed to realize the functions and competencies of a humanoid robot with the help of large ensembles of intelligent agents processing large data on high-speed huge computing resources. Large ensembles of intellectual agents require functional self-organization. The article proposes the approach and technology of functional harmonious self-organization of large ensembles of intellectual agents. Human communication of internal speech with a communicative associative robot through the neurointerface is discussed in the third section.The fourth section deals with a supercomputer with artificial intelligence for the functioning of large ensembles of intelligent agents. The fifth section deals with the client design-oriented training of specialists for robotics with artificial intelligence of library activity and various industrial fields and social services.

## Improving artificial intelligence

Practical development of strong artificial intelligence.

For the development of strong artificial intelligence, a standard case for its application is proposed. The standard case is approved by the Japanese Technical Committee for Standardization of Artificial Intelligence. It has the status of an international standard [10].

The Application of Strong Artificial Intelligence international standard case consists of seven tables containing attributes, characteristics, properties, parameters and qualitative indicators and criteria for the development of artificial intelligence of various systems.

Standard Application of Strong Artificial Intelligence Case:

**Table 1: General**

| **Use case name** | **Application of Strong Artificial Intelligence** | | | |
|---|---|---|---|---|
| Application domain | Hi-Tech Labor Market | | | |
| Deployment Model | Human digital double | | | |
| Status | Results of research: Strong Artificial Intelligence | | | |
| Scope | Economic sectors and social services | | | |
| Objective(s) | Find accurate and universal application of strong artificial intelligence. | | | |
| Narrative | Short description (not more than 150 words) | Strong Artificial Intelligence-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. | | |
| | Complete description | Technology that studies the development of chelatinous digital twins capable of acquiring, processing and applying human knowledge and skills, purchased through training, to solve problems, adapt to changing circumstances with or without human or external control in physical work, as well as in mental or cognitive work. Technology builds models by analyzing quantitative and qualitative data from different perspectives and measurements, classifying them, and summarizing potential relationships and impacts. The technology uses natural language processing and machine learning to interact more naturally and expand human experience and knowledge on a permanent basis during operation. The technology has robust mechanisms by which to ensure security in way that humans would understand. Technology showing smart behavior comparable to human across the range of cognitive abilities. The technology models the spectrum of human abilities by retraining. The technology relies on the infrastructure of interconnected actors, people, systems and information resources of high-tech industry and social sphere, as well as on services that process and respond to information from the physical and virtual world of social cognitive smart robots: guide, seller, teacher, nurse, volunteer, guard, administrator. | | |
| Stakeholders | Highly technological producer | | | |
| Stakeholders' assets, values | Reputation | | | |
| System's threats and vulnerabilities | Legal and ethical aspects of interaction with society. | | | |
| Key performance indicators (KPIs) | ID | Name | Description | Reference to mentioned use case objectives |
| Key performance indicators (KPIs) | 1 | AI management of professional cooperation process | The technology of creative processes control can itself predict optimal terms of execution of certain stages on the basis of accumulated information about their labour intensity, selection of the route of staff load and competences of employees. Optimize processes during their execution-automatic delegation of tasks taking into account the load of employees and their competences. | Improve accuracy |
| | 2 | Productivity and quality AI | Strong artificial intelligence works with fewer mistakes and is safer. Strong artificial improves the quality of life of man and society in daily concerns, as well as productivity in high-tech industry and production. | Improve efficiency |
| AI features | Task(s) | Creative activity | | |
| | Method(s) | Deep learning | | |
| | Hardware | Supercomputer with Strong Artificial Intelligence | | |
| | Topology | Distributed Modular Interconnect Topology | | |
| | Terms and concepts used | Deep learning, "imagification", neural network, training, training data set | | |
| Standardization opportunities / requirements | Strong artificial intelligence requires process standardization, as does every human activity. | | | |

| | | |
|---|---|---|
| Challenges and issues | Qualitatively new type of thinking not available to humans. | Security and ethical and legal aspects |
| Societal concerns | SDGs to be achieved | Universal approach to big data processing with smart cognitive systems |

**Table 2. Data**

| **Data characteristics** | |
|---|---|
| Description | Strong Artificial Intelligence Data |
| Source | Model and technology of Strong Artificial Intelligence |
| Type | Strong |
| Volume (size) | Hi-Tech Labor Market |
| Velocity (e.g. real time) | Supercomputering Velocity |
| Variety (multiple datasets) | streams of multiple datasets |
| Variability (rate of change) | Retraining |
| Quality | High |

**Table 3. Process scenario**

| **Scenario conditions** | | | | | |
|---|---|---|---|---|---|
| **N.** | **Scenario name** | **Scenario description** | **Triggering event** | **Pre-condition** | **Post-condition** |
| 1 | Training | Train a model (deep neural network) with training data set | Technological process raw data set is ready | Formatting of data | Management of safety |
| 2 | Evaluation | Expansion of the trained model | Development of technological thinking and behaviour | Cognitive thinking patterns and psychological behaviors | Meeting KPI requirements is condition of development |
| 3 | Execution | Model and Technology Tooling | Interaction | Activization of Model | Completion of interaction |
| 4 | Retraining | Retrain a model with training data set | Certain period of time has passed since the last training/ retraining | Additional data and knowledge | Combining Data and Knowledge |

**Table 4:** Training.

| **N.** | **Scenario name** | **Scenario description** | **Triggering event** | **Pre-condition** | **Post-condition** |
|---|---|---|---|---|---|
| 1 | Sample raw data set is ready | Specification and classification | Manufacturer | Transform sample raw data | Strong AI Software |
| 2 | Completion of Step 1 | Creating Set of Experimental Data | Manufacturer | Development of set of experimental data through job modelling | Software of modelling |
| 3 | Completion of Step 2 | Model training | AI solution provider | Train a model (deep neural network) with experimental data set created by Step 2 | |

**Table 5: Evaluation**

| **Step No.** | **Event** | **Name of process/ Activity** | **Primary actor** | **Description of process/activity** | **Requirement** |
|---|---|---|---|---|---|
| 1 | Completion of training/retraining | Research | Manufacturer | Train model (deep neural network) with experimental data set created | Strong AI Software |
| 2 | Completion of Step 1 | Identification | AI solution provider | Based on data, detect execution using a deep neural network trained in learning scenario | Software of modelling |
| 3 | Completion of Step 2 | Evaluation | Manufacturer | Comparison of phase 2 results with human performance | |
| Input of evaluation | | | | | |
| Output of evaluation | | | | | |

**Table 6: Execution**

| Step No. | Event | Name of process/ Activity | Primary actor | Description of process/activity | Requirement |
|---|---|---|---|---|---|
| 1 | Completion of comparison of modeling results with human performance | Research | Manufacturer | Development of a set of experimental data through job modelling | |
| 2 | Completion of Step 1 | Identification | Manufacturer | Based on modified data train model (deep neural network) with experimental data set created | The trained model with deep neural network has to be handed over to the manufacturer |
| 3 | Completion of Step 2 | Evaluation | Manufacturer | Comparison of phase 2 results with human performance | |
| Input of Execution | | | | | |
| Output of Execution | | | | | |

**Table 7:** Retraining

| Step No. | Event | Name of process/ | Primary actor | Description of process/activity | Requirement |
|---|---|---|---|---|---|
| Activity | Primary actor | Description of process/activity | Requirement | Development of a set of experimental data through job modelling | |
| 1 | Certain period of time has passed since the last training/ retraining | Research | Manufacturer | Additional data and knowledge | |
| 2 | Completion of Step 1 | Experimental data set creation | Manufacturer | Combining Data and Knowledge | |
| Based on modified data train model (deep neural network) with experimental data set created | | | | | |
| 3 | Completion of Step 2 | Model training | AI solution provider | Comparison of phase 2 results with human performance | |
| Specification of retraining data | | | Retraining data set has to include recent data | | |

**Developing Artificial Intelligence by Intelligent Agent Ensembles**

Intelligent agents with synergistic interaction form ensembles. Rapid, efficient data collection and analysis, flexible, rapid data-refresh mobility, and a synergistic, open collaboration of intelligent agents with information platforms and analytics systems help accelerate the digital transformation of the high-tech industry and social sphere by training new skills. Interaction of intelligent agents of the ensemble with information platforms and analytical systems is facilitated by a standard case of synergistic interaction [11].

New skills are taught in a virtual space and then developed in a specific environment. The accumulation of professional experience in virtual space contributes to the development of artificial intelligence in the industrial environment.

**Building an ethical digital environment with smart artificial intelligence**

Intelligent agent ensembles allow you to create a digital environment with professional images with language, behavioral and active communications, when images and communications are implemented by agents with intelligent artificial intelligence. Through language, behavioral and active communications, intellectual agents implement collective activities. The ethical standard through intelligent agents allows you to regulate the safe use of ensembles made of robots and digital doubles with creative communication artificial intelligence in the social sphere, industry and other professional fields. The use of intelligent agents with smart artificial intelligence requires responsibility from the developer and owner for harming others. If harm to others occurred due to the mistakes of the developer, then he bears responsibility and costs. If the damage to others occurred due to the fault of the owner due to non-compliance with the terms of use, then he bears responsibility and costs. Ethical standard and legal regulation help intellectual agents with intelligent artificial intelligence become professional members of society. Ensembles of intelligent agents with smart artificial intelligence will be able to safely work with society as professional images with skills, knowledge and competencies, implemented in the form of retrained digital twins and cognitive robots that interact through language, behavioral and active ethical communications. Cognitive robots and digital doubles through self-developing ensembles of intelligent agents with synergistic interaction and intelligent artificial intelligence can master various high-tech professions and competencies. Their use in the industry increases labor productivity and economic efficiency of production. Their application in the social sphere improves the quality of life of a person and society. Their widespread application requires compliance with an ethical standard so that their use does not cause harm. The introduction and use of an ethical standard for the use of cognitive robots and digital doubles with smart artificial intelligence increases the safety of their use. Ethical relationships between individuals and intellectual agents will also be governed by an ethical standard.

**Standardization of artificial intelligence for development and use of intelligent systems**

The ISO has an international technical committee for standardization of artificial intelligence ISO/IEC JTC 1/SC 42 "Artificial Intelligence." National technical committees for standardization of artificial intelligence have been established in technologically

developed countries. National technical committees develop national artificial intelligence standards. They are subcommittees of the international committee on certain areas of standardization. The International Committee approves international standards through national subcommittees. The standard Application of Strong Artificial Intelligence case is approved by the Japanese Technical Committee for Standardization of Artificial Intelligence. It is international standard [10].

**Strong artificial intelligence with technological singularity**

Fifty years of Moore's Law. Quantum computers, DNA computers, neural networks are being developed. The exponential growth of technology and progress is now observed. Everything inevitably indicates a further acceleration of progress and movement to a certain point - the technological singularity. If you look at the history of the information development of man and technology, then you can notice several patterns. Simplest Nervous System - > Brain - > Speech - > Writing - > Computers and the Internet. Each next stage came much faster than the previous. Information technologies, in cooperation with others, give two main products: strong artificial intelligence with technological singularity and a human-robot interface. The singularity of strong artificial intelligence, as a feature of the search for solutions, in conditions incomprehensible to humans, by cognitive intelligent systems based on the accumulated experience of risk situations by processing the accumulated smart big data with strong artificial intelligence, will help make safe decisions at risk. Strong artificial intelligence by processing big risk data finds a secure, cost-effective solution. Solutions are in simulation mode first. If the model provides up to 90% of solutions in risky situations, then it is considered satisfactory. Building models and building big data for risky environments and situations is now critical to disaster prevention and security. The development of strong artificial intelligence to find solutions to prevent disasters and ensure safety is an urgent task for the scientific and engineering community.

**Structural aspects of cognitive library robot**

The cognitive library robot has the system of a discernment of the interlocutor, the system of speech input of informational requirements, the system of realization of informational requirements (the system of imitation of imitative thinking), the neural network system of synthesis of the speech in the text of realization of informational requirement.

The system of realization of informational requirement contains the system of assimilation of knowledge, the system of symbolical and language communication, the system of tutoring, a knowledge base, base of abilities, the neural network system of reading printing system and the system of graphic display. The system of tutoring contains subsystems of machine translation. The system of a discernment of interlocutors is neural network system.

Informational unit of communication of the person with the robot is informational requirement. The interlocutor uses informational requirements which contain in a robot knowledge base and also a combination of informational requirements. The robot receives new informational requirements and their realization during its tutoring. Polysemantic words of informational requirement have a semantic marking. Cognitive navigation of the robot on its realization is carried out through the intrinsic dictionary. For example, the semantic marking of the word "put" indicates or a lexical meaning, or arithmetic action, or behavioural action.

Acquaintance of the robot to the person is carried out through the neural network system of face recognition. If the person is unknown to the robot, then the receptive system remembers its speech dictionary and the person. If it is known to the robot, then the system will customize the system of speech input of informational requirement on the speech dictionary by the interlocutor. After that the informational contact between the robot and the person begins.

**Management of behavior of library robot**

Behavior of the created robot the multifunctional hierarchical system of controllers, similar to a control system of behavior of a human body operates. The behavior arises under the influence of informational requirement which causes orientation in a situation on models of the external environment and behavior. Orientation comes to the end with the choice of the corresponding line-up of programs of hierarchical system of controllers as instructions to actions which realization leads to realization of behavior. Advantage of the organization such consists in development of behavior of the robot on the basis of expansion of hierarchy of the subprogrammes setting acts of behavior.

The controller is a computer on a chip. It is intended for control of various electronic devices. The controller of the robot is the diminutivest computer. It contains the processor and peripheral devices: FLASH memory, timers, interfaces for communication with peripheral equipments and a set of other useful schemes. The controller operates according to the given program which is loaded into it from the potent computer. It is loaded by means of a programmator (in the simplest look is an express cable) into the microcontroller.The robot has bodies for interaction with a surrounding medium. Bodies which obtain information from a surrounding medium are called receptors (or sensors). And bodies which influence a surrounding medium – effectors: engines, loudspeakers, light-emitting diodes and so forth. The controller has a quantity of entrances and exits. To entrances receptors, and join exits effectors. Microcontrollers can process information from entrances and create electric signals at the exits how we will program behavior of the robot.

**Hierarchical algorithms of actions of behavior of library robot**

Hierarchical approach to realization of actions of behavior of the cognitive mobile robot allows it to perform the useful effect and to provide the movement. Hierarchical algorithms of actions of behavior are divided on agglomerative and divizimny. Agglomerative algorithms begin the realization with the fact that each action is brought in the corresponding cluster and in process of realization unite clusters until at the end does not receive one cluster including all actions of behavior. Divizimny algorithms, on the contrary, at first refer all actions in one cluster and then divide this cluster until each effect is not had in a sootvetstvushchy cluster. Representation of result of a hierarchical algorithm is the dendrogramma - the scheme showing in what sequence there was a merge of actions in a cluster or division of actions into clusters.

Such approach allows to formalize requirements to mobility of behavior of the robot and to develop all possible algorithms of reaction to change of a condition of an environmental situation. For example, when moving on the street applying technology of satellite navigation, and environmental objects, finding by means of cameras or range finders.

**Robots with artificial intelligence and spectroscopic vision**

The artificial intelligence of a robot is a digital twin of human intelligence, capable of learning, retraining, self-realization and the development of professional and behavioral innovative competencies and skills. The robot represents a technological and software cognitive complex. The implementation of artificial intelligence by a robot is carried out on the basis of the criterion of

preferences of accumulated professional and behavioral innovative competencies and skills. Spectroscopic vision of the robot perceives objects and objects according to their frequency spectrum. To teach the robot to recognize objects and objects, frequency spectral technology of machine learning is used. Spectroscopic vision perceives the spectrum of radiation of objects, and an artificial trained neural network recognizes them from the spectrum. Robots with artificial intelligence and spectroscopic vision is presented in Figure 1.

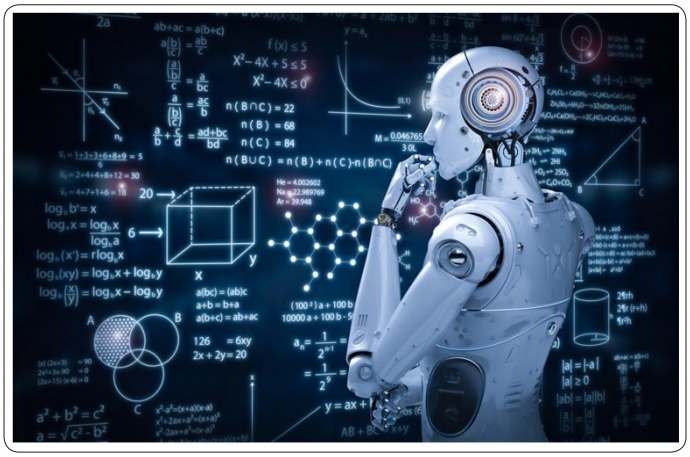


Figure 1. Intelligent robot with Technological thinking and spectroscopic vision

Cognitive smart architecture includes artificial neural networks, machine learning algorithms, smart big data cognitive system, high-quality selection system. The cognitive architecture of the robot based on the preference criterion develops functional activity. The smart cognitive architecture of the robot determines step by step how best to achieve the given goals and realize preferences through the actions of the utility function based on high-quality selection. Professional self-improvement is carried out by machine retraining according to the criterion of preferences on the basis of extensive statistics of qualitative selection of accumulated creative innovative skills and competencies in the sixth technological order of industry 4.0. The robot's intelligent cognitive ability is developed by artificial intelligence through machine retraining, based on competencies accumulated in the knowledge base and in the skills base of the corresponding professional and behavioral skills.

Multilayer holographic neural network architecture has an array of neurons m x n where m is the number of Fourier decomposition descriptors and n is the dimension of the input vector. Weights in the first layer have the physical meaning of the frequencies with the highest energy, and weights in the second layer have the meaning of Fourier series coefficients. Thus, the number of inputs at each neuron of the output layer is m * n, which corresponds to the number of Fourier series coefficients. Creating an array of neurons requires the use of large computational resources.

In recognition tasks at the output, neural networks receive an belonging function, the value of which lies in the range from zero to one. Fourier transform for pattern recognition is used to obtain it. The network recognizes binary images. It takes complex numbers at the input, after which it approximates the function of belonging to the image.

Before recognition, algorithms are used to binarize and bring the target image to the general form. Then it is supplied completely to the artificial neural network with Fourier transformation. Separately, real and imaginary components are supplied full of parametric sequences of necessary and sufficient data of holograms of the target image, after which the image is recognized. The unambiguity of image recognition in different environments and different conditions is proved by the uniqueness theorem.

Uniqueness theorem. The integrable function uniquely defines the coefficients of the Fourier series or Fourier transform. The complete set of Fourier series coefficients or Fourier transform uniquely defines the corresponding function.

For processing layer-by-layer holographic information, a recurrent neural network with a Fourier row is used. Time domain convolution is used for frequency domain multiplication. The Fourier transform is used in machine additional learning with a model of reinforcement of one's own or another's, help to build fully parametric sequences of necessary and sufficient hologram data.

Multi-modal synergy of holographic neural network layers with additional training with new holograms allows, together with an ensemble of intelligent decision-making agents, to develop qualitative solutions.

Robots with spectral holographic properties contain neural network multilayer systems with additional training, ensembles of intelligent agents and holographic memory. Robots can solve many different practical problems in medicine, banking, industry, education, hospitality and even entertainment are the main areas of application of robots.

The actual use of robots with artificial intelligence is currently falling on libraries [11-12].

In the municipal library of Osaka (Japan), there is a library robot, in kote format, that helps the reader find a book on the shelf. Select a book from the electronic catalog, print the barcode, scan it - and the cyber cat will guide you to the desired book.

ZhiTu, an artificial intelligent robot developed by Tianjin University (TJU), has been set to work in the school's library to manage the book collections. Featuring various cutting-edge technologies spanning robotic navigation, map construction, radio frequency location, computer vision and artificial intelligence (AI), ZhiTu was developed by a group led by professor Li Keqiu, winner of the National Outstanding Youth Science Foundation Award and director of the College of Intelligence and Computing at TJU. The robot is able to intelligently manage the books, being generally more particular and efficient than a human. It can automatically form a map of the library, while moving around, with the help of the laser radar installed at its base, and it is able to adapt to new and complicated places quickly. In addition, the robot is equipped with sensors with high precision to make way for barriers and people. The radio frequency identification (RFID) inside the robot can scan the books on shelves automatically when checking books and read the label information, yet the RF signal is easily disturbed by various elements such as the multipath effect. The research group applied computer vision and AI to read the words on books' spines to avoid errors. Aside from the robot, the research group has also developed a system named Zhiqu, which is installed on the upward side of the bookshelves. This system catches the movements of users while they are browsing books in order to offer recommendations and provide guidance in book purchasing, based on users' interests. Chinese robot librarians Tutu and Wanbao help readers find the books they need.

**Human-Robot Communication via Neurointerface**

Neurointerfaces are used for dialogue and control with communicative associative robots using high-tech wireless communication means for receiving and transmitting messages. The most suitable technology for implementing the wireless neurointerface is the Bluetooth Low Energy wireless data technology, best known by its abbreviation (BLE). A special advantage of the technology is its prevalence on a huge number of devices, primarily devices with autonomous power supply, i.e. mobile or wearable. Mental communication with the communicative associative robot is carried out through its intelligent communicator agent.

Human communication with the robot through the neurointerface opens up new effective ways of organizing library work (Figure 2).



**Figure 2:** Human-Robot Communication

Programming of Cognitive Social and Industrial Smart Robots

Social robot software is created in programming languages. Many programs for generalizing architecture were implemented in the language of behavior that was defined by Brooks. This language is a rule-based real-time control language that compiles AFSM controllers. Separate rules of this language, defined using syntax similar to Lisp, are compiled into AFSM machines, and AFSM machine groups are combined using a set of mechanisms for transmitting local and global messages.

Universal robotic language, or abbreviated GRL (Generic Robot Language). GRL is a functional programming language for creating large modular control systems. As in the language of behavior, in GRL, state machines are used as the main building blocks. But as a setting over these machines, the GRL language offers a much wider list of designs for determining communication flow and synchronizing constraints between different modules than the behavior language. GRL programmes are compiled into effective programmes in command languages such as C.

Another important programming language (and related architecture) for parallel robotic software is the Reactive Action Planning System (RAPS). The RAPS system allows programmers to set goals, plans related to these goals (or partially define a policy), as well as set the conditions under which these plans are likely to be successfully implemented.

Crucially, the RAPS system also provides tools to deal with the inevitable failures that occur in real robotic systems. The programmer can specify procedures for detecting failures of different types and provide an exception procedure for each type of failure. In three-tier architectures, RAPS is often used at the execution level, allowing you to successfully cope with unforeseen situations that do not require rescheduling.

There are also several other languages that allow the use of reasoning and learning tools in robots. For example, Golog is a programming language that allows for the immaculate interaction of algorithmic problem solving (scheduling) and reactive control tools specified directly using the specification.

Golog programs are formulated in terms of situational calculation, taking into account the additional possibility of using operators of non-deterministic actions. In addition to the specification of the control program with the capabilities of non-deterministic actions, the programmer must also provide a complete model of the robot and its environment.

Once the control program reaches the point of non-deterministic selection, a scheduler (set in the form of a theorem proof program) is called to determine what to do next. Thus, the programmer can determine partially defined controllers and rely on the use of built-in schedulers to accept the final selection of the control plan.

The main attractive feature of the Golog language is the impeccable integration of reactive control and algorithmic control provided for in it. Despite the fact that when using the Golog language you have to comply with strict requirements (full observability, discrete states, full model), this language has created high-level controls for a number of mobile robots designed for indoor applications.

The language “JSk CES (short for C++ for embedded systems - C++ for embedded systems) is a C++ language extension in which probabilistic and learning tools are combined. CES data types include probability distributions, which allows the programmer to make calculations using undefined information without spending the effort that is usually associated with implementing probabilistic methods.

More importantly, the CES language enables the customization of robotic software through example-based learning, much like what is done in learning algorithms. The CES language allows programmers to leave “gaps” in the code, which are filled with training functions; typically such gaps are differentiable parametric representations such as neural networks. In the future, inductive learning takes place using these functions at certain stages of the training, for which the teacher must set the required output behavior. Practice has shown that the CES language can be successfully applied in problem areas characteristic of a partially observed and continuous environment.

The ALisp language is an extension of the Lisp language. The ALisp language allows programmers to specify non-deterministic selections similar to Golog selections. But in the ALisp language, for decision making, it is not the theorem proof program that is used, but the means for determining the correct action using inductive learning, which use reinforcement learning. Therefore, the ALisp language can be considered as a convenient way to incorporate knowledge of a problem area into a training procedure with reinforcement, especially knowledge of the hierarchical structure of the “procedures” of the desired behavior. Until now, the ALisp language has been used to solve robotics problems only in simulation studies. It can be used to program robots with imitative thinking and adaptive behavior, capable of learning when interacting with the environment.

Python has become the main language for AI. Python is a high-level programming language that has recently become increasingly prevalent in AI development. Its simple and intuitive syntax, vast library support, and wide community make it a preferred choice for many developers.

The hierarchical approach to implementing the actions of the behavior of a cognitive mobile robot allows it to perform useful work and ensure its movement. Hierarchical algorithms of behavior actions are divided into agglomerative and divisional. Agglomerative algorithms begin their execution with the fact that each action is entered into the corresponding cluster and clusters are combined as they are performed, until at the end there is one cluster that includes all actions of behavior. Divisional algorithms, on the contrary, first assign all actions to one cluster and then separate this cluster until each action is in the corresponding cluster. A representation of the result of a hierarchical algorithm is a dendrogram - a diagram showing in which sequence actions merged into a cluster or divided actions into clusters. This approach allows you to formalize the requirements for mobility of robot behavior and develop all possible algorithms for responding to changes in the state of the environment. For example, when moving on the street, using satellite navigation technology, and surrounding objects, detecting using cameras or rangefinders. That is, the approach allows autonomous robotic systems to be designed for the implementation of many social spheres of life [13-14]. Cognitive robots with semantic emotional thinking and adaptive behavior have the prospect of widespread practical use as smart robots in the social sphere.The National Institute of Advanced Industrial Science and Technology in Japan (AIST) showed a humanoid robot HRP-4C, which is capable of voice communication, reading books aloud, singing, and emotional response. HRP-4C analyzes the facial expression of a singing person and the sound stream, as a result of which it synthesizes its own audio track, and also repeats the facial expressions of the human singer.

The Japanese company SoftBank has created a Pepper robot with an artificial intelligence system, which allows it to analyze gestures, vocal signals and human expression. You can communicate with him as with a loved one, as well as give him tasks.

At the Japanese National Institute for the Study of Matter, an international group of scientists is developing a robot with an artificial mind. It is connected to the culture of brain neurons grown from living nerve cells in the laboratory. Scientists forced him to pass the maze and achieve the goal. When the robot moved in the wrong direction, neurons in the cellular culture were subjected to electrical stimulation. As a result of the impulse, the car chose the right path and safely reached the goal. Experiments will marked a big step forward in the desire to teach robots to the mind.

**Social Cognitive and Industrial Smart Robots**

Smart robots become independent objects of the social environment. Social cognitive smart robots are used as librarian, hotel administrator, guide, salesman, lecturer, vacuum cleaner, nurse, volunteer, security guard and other smart robots. Example see figures 3-15.



**Figure 3:** Chine library robot



**Figure 4:** Indian library robot



**Figure 5:** American intellectual library system for issuing books



**Figure 6:** Russian library robot guide



**Figure 7:** Japanese robot-administrator of hotel Henn-na Hotel



**Figure 8:** American mobile robot security guard Atlas with adaptive behavior




**Figure 9:** Japanese robot lecturer on literature

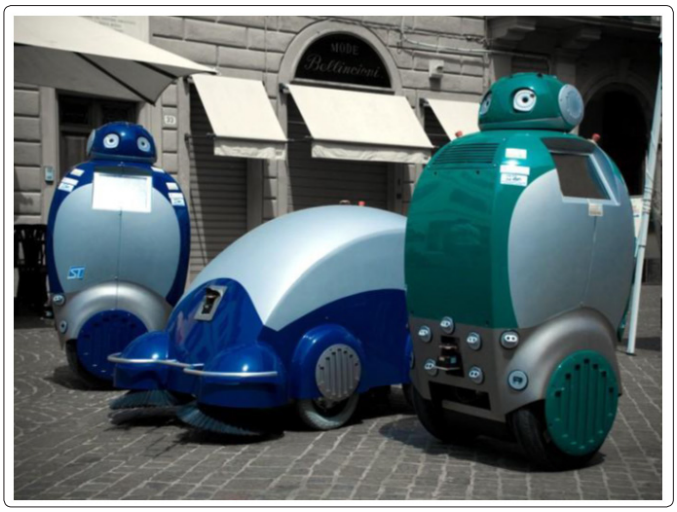


**Figure 10:** European smart cleaning robots



**Figure 11:** Intelligent industrial Chine robot



**Figure 12:** German aerial unmanned taxi



**Figure 13:** Russian tram without driver.



**Figure 14:** Russian car without a driver.

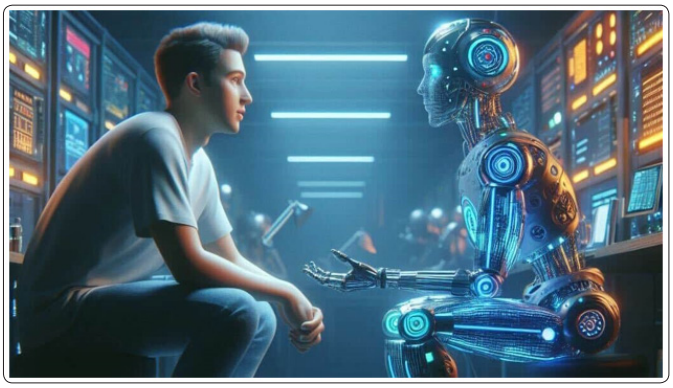


**Figure 15:** Multimodal generative intelligent robot with bioinformation holographic memory.

## Conclusion

The Internet is filled with knowledge from all spheres of life. He is more erudite than every person, but less erudite than humanity of all generations. Experts strive to create a smart human-like

robot. The creation of a humanoid robot is associated with the implementation of a large number of functions and competencies. The author proposed to realize the functions and competencies of a humanoid robot with the help of large ensembles of intelligent agents processing large data on high-speed huge computing resources. Large ensembles of intellectual agents are configured by self-organization. The article proposes the approach and technology of self-organization of large ensembles of intellectual agents on the principle of gold section.

Large ensembles with strong artificial intelligence and technological singularity are in great demand in the industrial and social sphere. Especially in environments and situations incomprehensible to the consciousness of specialists, where huge risks arise. Strong artificial intelligence with technological singularity can help governments establish life models for society, and which increasingly do not lead to the expected results. Large ensembles with strong artificial intelligence and technological singularity, taking into account the states of the real environment, by processing large data about them and modeling the life of society, can help humanity follow a safe path of existence. The development and successful introduction of strong artificial intelligence with a technological singularity can fundamentally change our lives. Strong artificial intelligence can lead to the optimal singularity. This hypothetical essence will help create an absolute order from the current chaos, for example: complete automation of transport and absolute control of road traffic, always stable economic growth, the absence of wars, the constant introduction of new technologies and the prevention of economic stagnation, as well as promising space exploration.

In 2023-2025, robotics and artificial intelligence were used in various industries such as healthcare, manufacturing, transportation, and agriculture. Robotics and artificial intelligence also use to automate tasks, improve efficiency, and enhance decision-making processes.

The future prospects of robotics and artificial intelligence are vast. They have the potential to revolutionize industries, create new job opportunities, and improve the overall quality of life. However, there are also concerns about the ethical implications and impact on employment.

So far, experts have not been able to create an intelligent social robot capable of consciously and emotionally reacting to various jokes or creating theories. Currently, multi -modal generative technologies of artificial intelligence continue to effectively transform various industries. Generative artificial intelligence is constantly improving and approaching in cognitive abilities to natural intelligence. Artificial intelligence builds activity on the basis of a productive system of rational and moral meanings approved by the practice. Productive meanings are active memory elements. Based on them, thinking is built in actualized situations and circumstances. Thinking is carried out on the basis of knowledge of holographic memory, taking into account the time and space of current events.

To create a creatively capable artificial intelligence similar to natural intelligence, it is necessary to create a full-fledged virtual environment in which the standards will be by norms of creativity and creation [15-16].

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